THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVII. No. 1705.] LONDON, JANUARY 14, 1896. [48TH YEAR. PRICE 6d.

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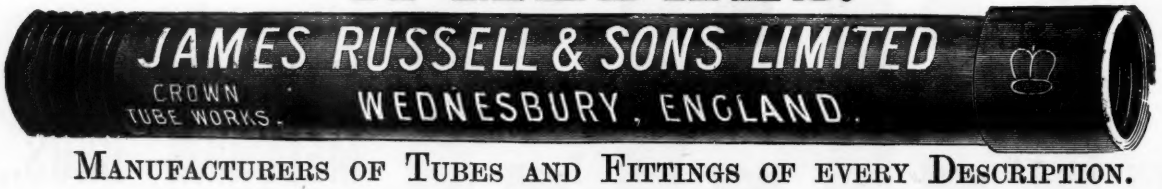

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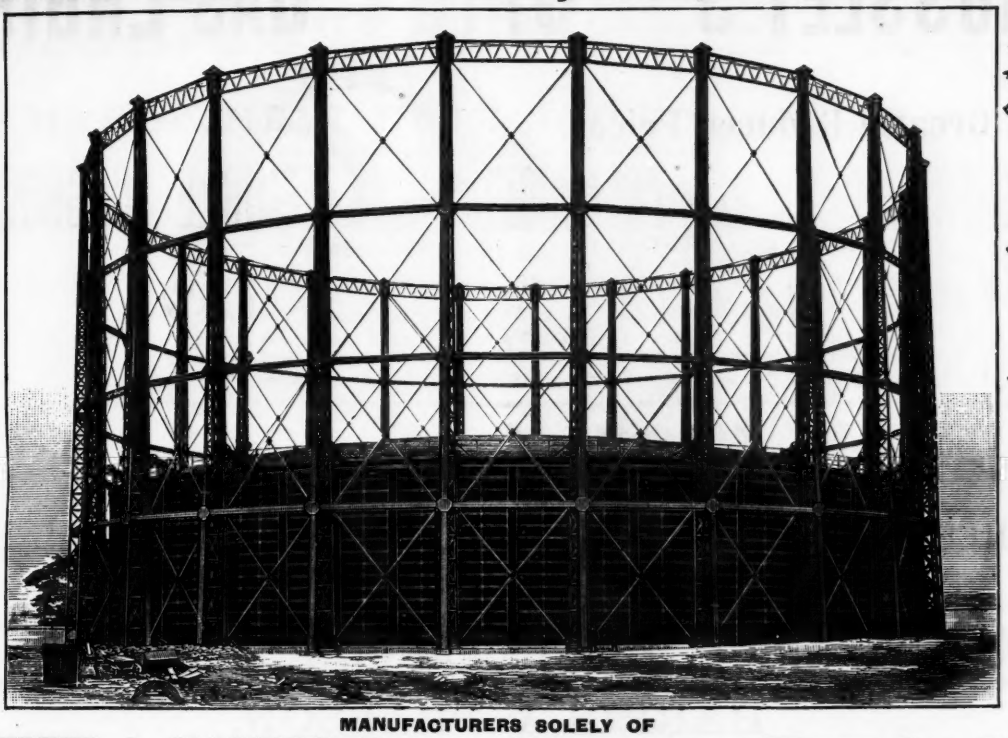

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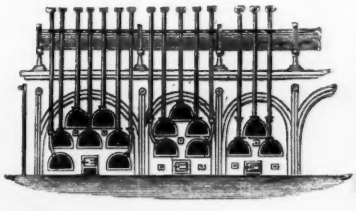

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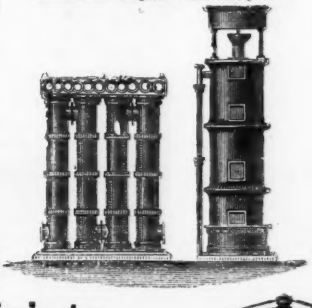

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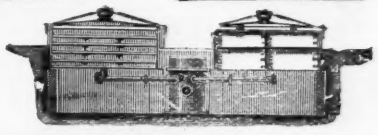

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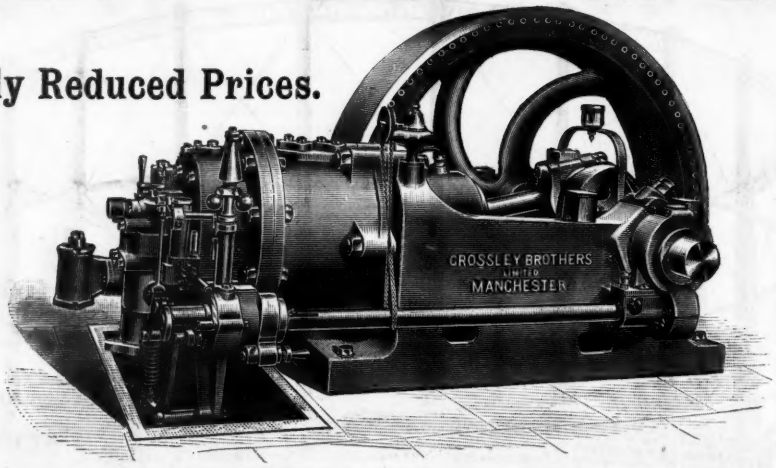

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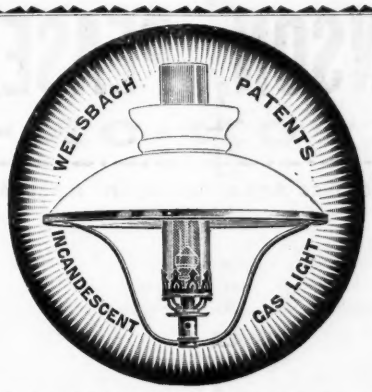

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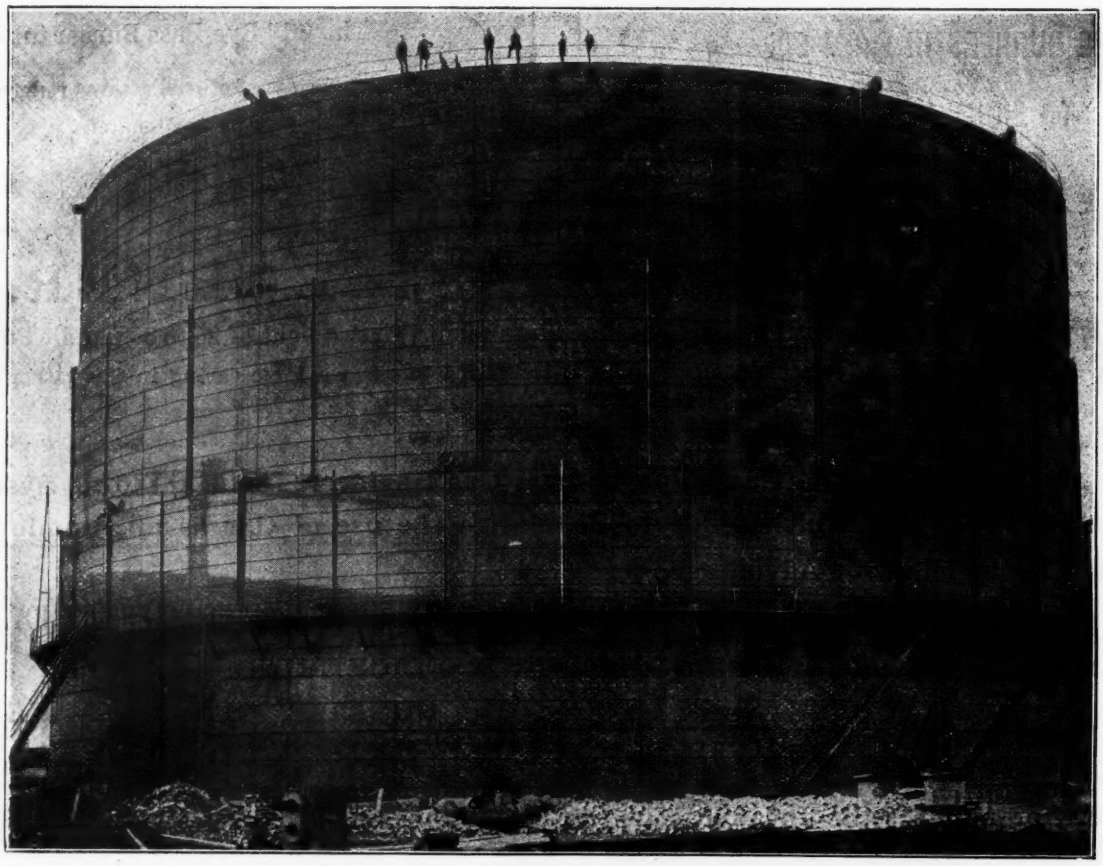

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Darlington.
Middlesbrough (see Illustration).
Selby.
Sligo.
Milan (Italy).
Horsens (Denmark).
Bathurst (N.S.W.)
Haslingden.
Birkenhead.
Barrow-in-Furness.
Tyne Docks.
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St. Austell.
Athens (Greece).
Cape Town (South Africa).

References to American and other Users.

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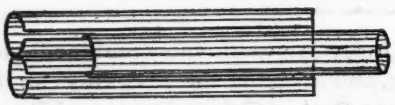
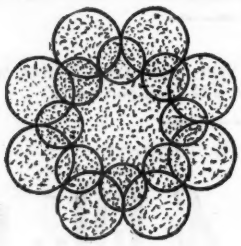


INTERLOCKED TUBING

PEASE'S PATENT.



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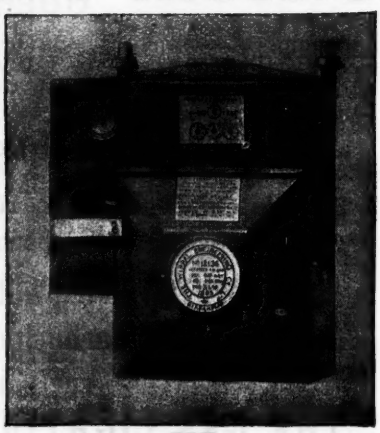

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(*Vide* JOURNAL OF GAS LIGHTING, *May* 22, 1894.)

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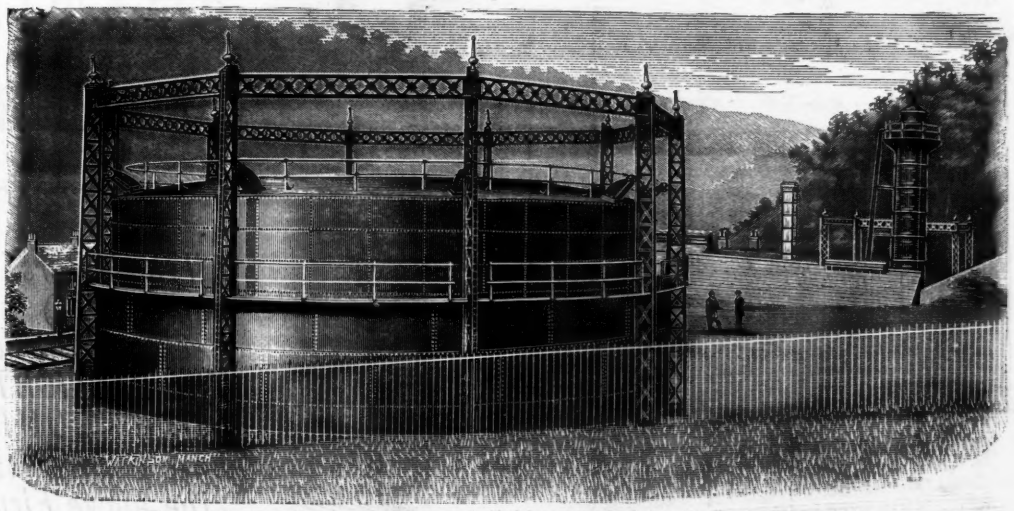

From Photo. of Steel Tank and Holder erected by R. D. & Sons, Ltd.

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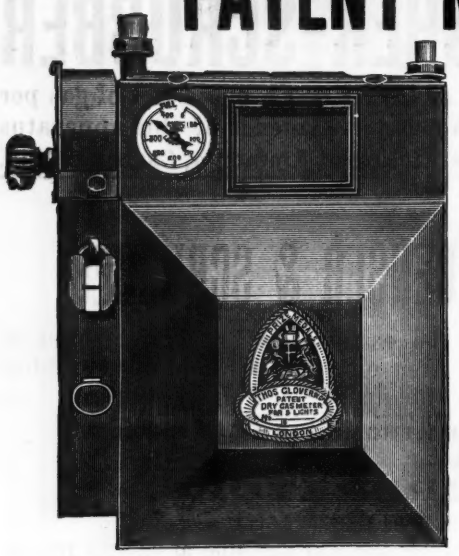

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Telegraphic Address: "GAS-METERS, BIRMINGHAM."

[See also Advt. p. 104.

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EDITORIAL NOTES.

The Gas Undertakings Returns.

THE annual returns relating to the authorized gas undertakings of the United Kingdom have been issued; that of the Companies being thus just over a twelvemonth after date. We give in another column the principal figures of these valuable official statements, which show that the 627 undertakings included in the returns—taking the Companies and Local Authorities together—employed at the dates of the returns a total paid-up and borrowed capital of £69,423,431. Their total receipts for the twelve months amounted to £19,408,265, and their expenditure on revenue account to £13,791,520. The coal carbonized for making gas weighed 11,319,301 tons, from which 114,295,680,000 cubic feet of gas were made; the quantity sold (exclusive of the amount consumed on the works) being 105,160,990,000. The gas-mains attained the total length of 23,310 miles; the number of consumers rose to 2,524,217, and the public lamps supplied with gas numbered 512,856. As we think has been remarked before in regard to these figures, it is impossible for the mind to grasp the significance of numbers of such astronomical proportions. We might make them yet more overwhelming, if we chose, by treating the data of gas consumption according to the fashion in vogue with electricians, and so reducing them to the equivalent of so many burners consuming 5 cubic feet, or any other fancy quantity of gas, per hour. Any such computation, however, would be vain and meaningless. It is more to the point to lay stress upon the evidence of the returns that the gas industry of the country is in a condition of prosperity, and of even rapid growth and development. This is shown by the annual returns of the amount of capital sold in recent years by Companies under the auction clauses, as well as by the carbonizing figures. In 1884, the amount of capital so disposed of was £2,810,415; in 1894 it amounted to £5,715,024. This represents both growth and development—the growth of the industry and the development of the Companies along the line marked out by legislation. The expansion of the industry has not been uniform year after year. There has all along been a steady, though not a large, reinforcement of the number of Local Authorities owning gas-works by transfer from the Companies' list, which may account in part for the fact that the sales of gas by the former have always shown a yearly increase. The Companies, however, exhibited a slight retrogression in 1893, which has since been more than made up for. Ten years ago, the number of gas consumers in the United Kingdom was 2,058,356, and that of gas-lit public lamps 387,288. Whatever may have been done by other means of lighting during the past decade, therefore, it appears that nearly half-a-million more consumers find gas necessary to their ease and comfort now than had made this discovery ten years ago, and 125,568 additional gas-lamps have been erected in the highways, thoroughfares, and bye-ways of the land during the same period to light the wayfarer on his road, and discourage the hoverers in the dark corners of our towns. There could not be a more satisfactory showing for any industry.

The Testing of Coin-Controlled Meters.

A MATTER of very considerable importance to gas consumers everywhere has been discussed in communications between the city authorities of Liverpool and Manchester. It has to do with the remarkable popularity of coin-controlled meters, which have of late poured into the testing offices in such numbers and variety as to raise some very reasonable misgivings in the minds of the responsible officials as to the sufficiency of the lawful tests which these appliances are alone required to satisfy before they are sent out for use with the Government guarantee of accuracy upon them. According to report, it is the intention of the Corporations of these neighbouring cities to move the Board of Trade to procure a strengthening of the law in this regard, so that the testing of meters may be a more thorough operation than it is at present. There is every reason to believe that any well-advised action in this sense will meet with warm support from the Standards Department. Gas-meters are actually tested merely for the measuring capability of the drum, which was a much more comprehensive indication of the working value of the instrument in the days of the undisputed supremacy of the wet meter than it is for the now generally

preferred dry meter. The reasons for this are sufficiently obvious, and need not be gone into at length here. It may, however, be as well to observe that, notwithstanding the shortcoming of the arrangements for testing meters, the public have not, as a matter of fact, suffered any positive injury; for it is clear, from the statistics of unaccounted-for gas all over the kingdom, that one type of meter measures gas on the average neither better nor worse than the other. Still, the dry gas-meter being what it is, the statutory test as to the accuracy of its registration is not so complete as might have been devised if the appliance had been a more familiar article of trade to the past generation than it actually was. And now the question of testing has been complicated by the addition to the registering apparatus of a coin-controlled attachment which the Legislature never anticipated when the subject of meter testing was last mooted with a view to some reform. The interest of the consumer in a meter of the last new class embraces the three elements of measurement, registration, and coin-control; and the legal test only applies to the first. Some years ago—to be precise, in 1888—the question of the expediency of testing indices was raised; and the Metropolitan Board of Works contemplated taking action to amend the Sale of Gas Act in this regard.

The addition of the coin-control attachment alters the question of testing in two ways. It sometimes interferes with the closing of the meter and its immunity from alteration which it is the object of the official tester's seal to prevent; and its own accuracy is nowise guaranteed. If the matter is to be strictly dealt with, everything in and about a meter in which the consumer's interest is involved ought to be properly tested. But then again arises the objection of expense. Few meter-testing stations pay expenses as it is; and if meters are to be tested with greater thoroughness, the work will take more time and cost more money. It would be undesirable to increase the cost of the coin-controlled meter by raising the testing fee to what would in every case be a remunerative figure; so that if the testing is to be more searching and complete, the localities where testing stations are established must be prepared for a heavier outlay on this account. Additional interest is imparted to the question by the circumstance that in some European countries the authorities are supposed to be considering the nature and extent of the testing to which coin-controlled meters should be subjected before being passed for public use. Curiously enough, it appears that while the "coin-in-the-slot" principle of trading has been carried in some parts of Europe to a far greater development than has yet been favoured in this country, the authorities have viewed its application to the sale of gas with much suspicion, or at any rate without cordiality.

A Protest against Municipal Scandalizing.

A CURIOUS episode occurred at the first meeting of the Manchester City Council for the year, when a request by one of the Citizens' Auditors for permission to overhaul certain books of the Gas Committee for 1893 and 1894, which had been refused by the Committee, was mentioned, and evoked what it is to be hoped the citizens generally will hold as a memorable protest from Alderman Sir John Harwood as to the conduct of certain individuals who have made a practice of holding the Corporation up to ridicule. The books in question have been inspected, audited, done with, and put away; and the Auditor who asked permission to see them did not say for what purpose he wanted them. But the object was guessed at by those who had been victims of the same gentleman's sarcastic remarks in the past, and who expect nothing better at his hands in the future. It was stated to be his habit to make up highly picturesque tales as to the details of the creature comforts consumed by the members of the Corporation Committees, at the public charge, when upon outdoor duty; and these "spicy" revelations have been made use of at election times, and indeed almost daily, in the endeavour to besmirch the personal reputation of certain honourable and upright public men. Sir John Harwood has been through a good many years of this sort of auditing; and he has now had enough of it. Though the redoubtable Alderman does not resemble the humble "worm" in many respects, the application of the sarcastic Auditor for permission to rake over old records gave him the opportunity of executing the proverbial reprisal; and he "turned" with tremendous effect upon the tormentor of town councillors. We have had many occasions for criticizing the policy and proceedings of the Manchester Corporation Gas Committee; but we have never descended to the puerility of discussing the hotel and refreshment bills of the members. This sort of thing is like potting at sentries in a campaign. It cannot possibly affect the main course of events, and only gives rise to a great deal of personal unpleasantness. The citizens of Manchester, moreover, recently had their constitutional opportunities for passing judgment upon their representatives on the City Council; and the circumstance that every retiring councillor who had been identified with the policy of the old Council was re-elected, is ample justification of Sir John Harwood's claim that this body has enjoyed, and still retains, the confidence of the ratepayers. From one point of view, therefore, it might be argued that petti-fogging cavillings at the system followed in doing the work of the city might be treated with contempt. But there is something, on the other hand, in what Sir John Harwood alleged as to the harm done by those who persistently try to scandalize the Corporation Committees, in deterring sensitive persons, "men of ability and social position," from coming into the Council and rendering public service. To fasten upon any public body the reputation of being composed of topers and wasters of the public resources in riotous living, is certainly one way of bringing about such a state of things.

Holding as we do the conviction that it is a condition of the first importance for the permanent success of our national system of local self-government that every inducement should be offered for the best men in every locality to recognize and perform their duty towards their neighbours in this regard, we heartily commend the outspoken words of Sir John Harwood in condemnation of the petty prying and tittle-tattling that too often passes for local criticism of the doings of municipal authorities. The evil, unhappily, goes very far beyond small pleasantries over charges for cigars and champagne supplied at municipal functions, albeit this is just the sort of *pabulum* that gutter newspapers like to fill up with between the obscenities and racing tips which constitute their customary chief attractions. The newspaper press of this country is, on the whole, conducted upon respectable, and often upon high, principles; but it is not to be denied that it often fails to discriminate between honest reporting and mere talebearing. One hears now a good deal about modern journalistic enterprise and the cause of progressiveness in municipal politics; but it must occasionally occur to all rightly-constituted people that it would do our popular newspaper editors, reporters, and correspondents no harm if their attention were forcibly directed at regular intervals to the Ninth Commandment, which remains valid notwithstanding all the "progress" of the world. As it is in Parliament, moreover, so it is with local authorities. The really important business transacted in public by these bodies passes with very little regard from the chronicler for the "popular" press. But let one member make a disturbance, and so occasion a "scene"—let some twopenny personal matter arise to interrupt the order of the day—and all the pencils go to work with a will, for the sake of sensational head-lines and contents bills in the next morning's or evening's issues. So the vanity of the demagogue, the ends of the agitator, are served; and the cause of good government is slighted.

The only possible remedy is for good men everywhere to take upon themselves the task of trampling all this sort of thing under foot. They can do it, if they will; and they will not fail of the support of the people when the public are enlightened as to what it means to put a set of posturing pretenders in charge of municipal affairs. The populace are caught sometimes by hare-brained talkers who will promise to create an earthly paradise for the poor man if they are returned to power. But the bubble soon bursts; and the properly qualified leaders of the community are sure to get their turn, if only they will take, and sacrifice themselves in the endeavour to deserve it. So far as Manchester is concerned, Sir John Harwood is right to be indignant at the unfounded aspersions that have been cast upon the Corporation Committees. But Alderman Hopkinson took the nobler way in declaring that nothing of the kind would discourage or deter him from working in the public service. Lastly, let us admit that intelligent, reasonable criticism of the minor details of corporation administration is perfectly in order, when directed to the subservance of the public interest, and done in the proper way.

An Old Friend in a New Office.

It is rather amusing to gas engineers to observe that their good friends the electric lighting engineers are just now having their turn at towns' refuse utilization. Time was when this same rubbish, with and without the admixture of sewage or sewage sludge, was highly recommended as good stuff for making illuminating gas from. Indeed, it is hard to say what the same kind of material has not been said to be good for, at one time or another, by various perfervid individuals who fancied it ought to be made useful somehow. One remembers how it used to be a commonplace of the sanitary science lecturer, in the days when it was rather fashionable than otherwise to attend lectures designed to improve the mind, to reproach modern civilization with deliberately wasting, in the forms of sewage and other domestic refuse, a most valuable stock of material. So it naturally came to pass that, when companies were floated for the purpose of turning to account this precious residue of civilized life, many a muddle-headed old gentleman who had the weakness of believing everything that he was told in long words by a gentleman with a string of letters after his name, sunk his money in these ventures. Later on the local authorities took their sewage and refuse in hand with a view to utilizing it; and even more money went in this way, only, as it came out of the rates, nobody was directly made insolvent thereby. First the joint-stock company; then the local authority—such is the order of more than one variety of modern "enterprise." It has now been proved, at a cost of a vast amount of wasted money and endeavour, that sewage is one of the few things wanted neither by Nature nor by man, in its state as sewage. Of course, Nature can make something of it, in her own way and after her own time; but then it is no longer sewage. Man can likewise put some value into it, if he chooses; but he has discovered that to do so is not business. House refuse is not exactly like sewage. It is not so hopelessly damp, for one thing; and even when largely diluted with brickbats, the latter have their own place in the scheme of things. The fact that house refuse can be made to burn, or can be carbonized, was long ago made the basis of attempts to convert all that was perishable in it into illuminating gas. Not very long since, we came across, in a *pseudo*-technical periodical, an illustrated description of how an ingenious country gentleman had fitted up in his back garden a private gas-works, consisting of a single iron retort of small dimensions, in which he made illuminating gas from all sorts of garbage collected from neighbouring houses. It seemed an odd kind of toy; but there is no accounting for taste. It is to hoped the gentleman was pleased with his gas after he had made it. Then, it was only the other day that a French inventor—M. de Livet—was heard of as being the designer of a description of steam-boiler that did rather better with house refuse than most steam generators could with best Welsh coal. The Receiver-General in Bankruptcy has not said his last word upon this notable scheme; and therefore we will leave the discussion of it for the present.

To return, however, to the consideration with which we started, towns' refuse has fallen into the hands of the electric light engineer, who has promised (in one or two individual examples) to so use it that gas will need to be sold for next to nothing if it is not to be driven from the field of competition. We have heard something very like this before; and consequently we are not quite so frightened at the rumour as we might have been if it had been less familiar. But we are not sorry that the electricians promise to have a try at utilizing towns' refuse for their own purposes. As the American Judge said to his queer client in Leland's poem, we "like to see young heroes "ambitioning like this!" Only, they must hurry up the phenomenon of a city lighting itself by its own dustbins, or there will be a hitch in the proceedings. The use of gas for cooking and heating is extending so quickly, that the dry refuse of many town districts at the present time does not contain one-half the combustible that would have been found in it ten years ago. The best friends of refuse destructors know that this is so; and they foresee that the destructor of the future will have as much as it can do to keep itself alight, especially in summer, to say nothing of having power to spare for raising any considerable weight of steam. Hence it would not be surprising if, after all, the electricians were to be driven to treat towns' refuse as did the gas engineers before them—that is, leave it alone.

WATER AND SANITARY AFFAIRS.

Under most promising circumstances, a new society, which is to be provisionally known as the British Association of Water Engineers, was founded on Saturday last. The want of such a body has been long felt; and yet it only required one person with sufficient energy to bring it into existence. To Mr. D. M. F. Gaskin, the Water Engineer of the Nottingham Corporation, belongs the honour of having single-handed successfully undertaken the task. It is fitting, by the way, that this gentleman should have been moved to take the initiative steps in this matter, and that the birthplace of the Association should have been the town which claims as one of its distinguished sons the late eminent Water Engineer, Mr. Thomas Hawksley. For some twelve months past, Mr. Gaskin has been turning the subject over in his mind, and quietly ascertaining the feeling in regard to it of those of his professional brethren with whom he has come into contact. He first gave publicity to his ideas respecting the matter in a letter published in the "Journal" and other technical papers at the end of November last; and he has been rewarded for what he has done by seeing his scheme develop and assume a corporeal form in the short space of two months. Judging by the number and standing of the gentlemen present at the meeting on Saturday (a report of the proceedings at which is given in another column), the future of the Association is assured. Close upon forty Engineers of the first order attended—several from very distant places—to start the scheme; and some fifty others have engaged to give it their active support. Among those present, we were pleased to see gentlemen who occupy the dual position of Gas and Water Engineers in their respective towns. One of these—Mr. Isaac Carr, of Widnes—has been placed on the Provisional Committee which was elected on Saturday; and his knowledge and experience of what has been, and is being, done in connection with similar organizations in connection with the gas industry will no doubt be of great value to his colleagues. Naturally, Mr. Gaskin was elected Chairman of the Committee; and he will have the valuable assistance of Mr. MacIntyre as Secretary. These two gentlemen will frame a set of rules which they will forward to each member of the Committee. Then, when the proposals are ripe for submission to the general body of members, a meeting will be called (we believe in London) to discuss them, and such emendations made as are considered necessary. No officers, excepting those appointed *pro tem.*, were elected on Saturday; but there is a very evident and proper desire on the part of several members to honour Mr. Gaskin by making him first President. As to the qualification for membership, though the title provisionally adopted for the Association will give the impression that it is to be confined to engineers, the general view seems to be that, in this particular, it should be conducted somewhat upon the lines of The Gas Institute—welcoming into its ranks all gentlemen holding official positions in connection with water undertakings, and likewise manufacturers and contractors for water-works plant.

There is one other point in connection with Saturday's meeting which may be mentioned here. One or two gentlemen, in private conversation, charged the "Journal," in a friendly way, with having neglected, in its technical columns, questions affecting water engineering. The reply to this is that the fault rather rests with the profession itself than with the "Journal." Owing to the non-existence of bodies in connection with the water profession such as is possessed by the gas industry, there have not been opportunities for keeping in friendly touch with water engineers, nor open meetings at which new inventions in water-works plant could be described and discussed, and other questions ventilated. It is true the Institution of Civil Engineers covers water, as it does other branches of engineering; but its meetings are, as is well known, closed to the Press. From what could be gathered at Saturday's meeting, there seemed to be a little undercurrent of feeling that the formation of the new Association would probably give some offence to the authorities in Great George Street; and, in fact, as will be seen by our report, in a letter to Mr. W. Matthews, the Water Engineer of Southampton, Sir Benjamin Baker, the President of the Institution, had urged delay in the matter of starting the Association, in order to give the Institution an opportunity of considering the question of holding sectional

meetings—thereby, we presume, perpetuating the exclusiveness which has hitherto characterized the proceedings of the Institution, and has given rise to complaint as to want of publicity in connection with the subject of water engineering.

In an article of considerable length, the Vienna correspondent of the "Standard" calls attention to the position of the water supply of the Austrian capital. A certain portion of the population has recourse to pumps and wells; but the principal supply is under the control of the Municipality, and consists of what is called the Hochquell water, derived from Alpine springs. Although this is really the town supply, on which Vienna is absolutely dependent, it is so deficient in quantity that the city is declared to be "in the permanent state of a water famine." The Municipality only undertake to supply their customers with 25 litres per head daily; and it is shown that the real amount is even less. Taking the full quantity, it comes to 5½ gallons per head—a stinted allowance, which would never be tolerated in London. There is an appearance of cheapness; but on examination, it will be found that this is illusory. The charge for the 25 litres per day is 1s. 6d. per annum; and the yearly volume would be practically 2000 gallons. Thus the annual charge would be 9d. per 1000 gallon; whereas the charge per 1000 gallons for the London supply, as shown by Lass's "Analysis," is only 7·155d. This is on the basis of the gross water-rental; whereas, after deducting empty houses and bad debts, the Companies only get 6·781d. per 1000 gallons, or little more than one-third the Vienna rate. No doubt the calculation requires some modification, owing to the circumstance that the London supply includes "other purposes" than those which are domestic. But this is not likely to effect any material alteration. One way in which the Vienna supply is made to appear cheaper than that of London, consists in showing that a house assessed at £480 per annum, and occupied by about eighty persons, bears a yearly water charge of less than £6, or at the rate of less than 3½d. in the pound on the assessment. But it has to be remembered that the Vienna Municipality only undertake to supply these eighty people with 5½ gallons per head daily, even if they get so much; whereas in London the daily domestic supply is 28 gallons per head, or five times as much. The eighty people in the Vienna house will—if they receive their full quantum—consume 160,600 gallons in the course of a year. At the London rate, the charge for this quantity would be less than £5, instead of less than £6. It may be as well to note the fact that the Vienna dwellings in question are without bathrooms. To this we may add that the system by which the Vienna water-rate is charged in the rent of the house makes no difference in the cost to the consumer, though it may humour him in the fancy that he is "not worried with water-rates." The argument that London is not charged for water per quantum, but according to rateable value, does not dispose of the fact that, under the present system, London gets its supply, on the whole, at a cheaper rate than Vienna. There is also the prospect that, in some way or other, the Austrian capital will have to bear in the future a heavier charge for water than it does now. This must be the case, if the supply is ever to reach its proper magnitude, and to include sundry purposes at present ignored.

Vienna, with an increasing population, is of necessity undertaking an extension of its water-works; and we find it reckoned that, for a sum of about £3,333,000, a minimum supply of 22 million gallons per day in summer, and 17 million in winter, will be obtained. If we take the mean of these two quantities as 20 million gallons, the yearly total will be 7300 millions, and the capital will be at the rate of £456 per million gallons; whereas the expenditure on the London works is at the much lower rate of rather less than £230 per million gallons. It is reckoned that the Vienna supply can be still further enlarged, so as to become 26½ million gallons per day. But this can only be accomplished by enlarging the capital expenditure, including the cost of cutting galleries, sometimes several miles long, through the solid rock. The correspondent of the "Standard" makes a very fair and striking comparison between the Vienna projects and the supply furnished in London. The present population of Vienna is nearly 1½ millions; but allowing that for a long time to come there will be old houses without Hochquell water, it is reckoned that the population dependent on the better supply may be taken as equal to that served over here by the East London Company. It is observed that during the worst time of the dearth of water last year in this Company's district, the quantity distributed was at the rate of 30 gallons per head daily for all purposes—a quantity which, it is said, the Vienna water-works, dependent on the present aqueduct, "can never reach." For a population of some 1½ millions, it would mean 45 million gallons per day, or nearly double the capacity of the aqueduct, quite independent of the yield of the mountain springs. For a lesser population, equal to that dependent on the Hochquell supply, it would mean more than 35 million gallons per day. The daily average of the East London Company during the year is upwards of 41 million gallons. The "Standard" correspondent puts it still higher; whereas the more moderate computation places the East London supply far ahead. As for the way in which Vienna is to get its wants adequately provided for, it is suggested that mountain springs must be sought in fresh districts, and that another aqueduct, of perhaps double the capacity of that now existing, will have to be constructed—"whether "of the length of 70 or 100 English miles is immaterial." After this, we do not see that London has much reason to envy Vienna in regard to water supply, or to complain that its Water Companies are seeking to incur too great an outlay for extensions.

The Secretaryship of the Cork Gas Company.—The late Mr. Denny Lane's successor in the secretaryship of the Cork Gas Company is Mr. O'Mahony, who has for some years been the Company's Chief Accountant.

Appointment of Mr. William Carr as Manager of the Stalybridge Gas-Works.—Mr. William Carr has been appointed Manager of the Stalybridge Corporation Gas-Works, in succession to Mr. E. A. Loam, whose resignation was announced in the "JOURNAL" a few weeks ago. The Gas Committee's decision in the matter was brought before the Council for confirmation at their meeting on Monday last week, when Alderman Holt remarked that Mr. Carr, who was "an old Stalybridgite," came to them with first-class credentials, and he personally had every confidence that the new Manager would do well for the town. Mr. Carr enters upon his duties forthwith. There were upwards of sixty applicants for the post.

The Wegener System of Powdered Coal Firing.—Messrs. Bryan Donkin and Co., Limited, have on exhibition at their works in the Southwark Park Road, Bermondsey, the system of smokeless firing, with powdered coal, invented by Mr. Carl Wegener. In this system, the coal is mechanically powdered until it is fine enough to pass through a 60 sieve, in which state it is fed into a hopper, and drawn into the furnace with the air required for supporting combustion, by the ordinary chimney draught. A saving of 20 per cent. of fuel is claimed for this system of boiler firing, which is due to the better combustion of the fuel, as shown by the high proportion of carbonic acid in the chimney gases. There is also a considerable saving of labour, owing to there being no stoking required in the ordinary sense of the term.

The Wellington (Salop) Managership.—Mr. Herman Taplay, formerly of Stoke-upon-Trent, has received the appointment of Manager of the Wellington (Salop) Gas-Works, which was rendered vacant by the removal of Mr. F. W. Cross to Lea Bridge. There were seventy candidates for the position. Mr. Taplay has had varied experience. He commenced his career under the late Mr. R. Jones at the Commercial Gas-Works. From there he went to Stafford to fill a position in the gas-works, and subsequently removed to Oswestry to take the management of the works. This post he gave up in order to go back to Stafford, where he was assistant. In 1881, he became Engineer and Manager to the Stoke and Fenton Joint Gas Committee. This was dissolved in 1882; and Mr. Taplay remained with the Gas Department of the Stoke Corporation until the early part of 1894. He is an associate member of the Institution of Civil Engineers.

Personal.—Mr. John Gandon, the Manager of the Ottoman Gas Company's works at Smyrna, has received the order of the Osmanié of the third class.——M. Bertrand and M. Berthelot, the Perpetual Secretaries of the Academy of Sciences, have been made grand officers of the Legion of Honour; and M. Moissan has been created an officer of the order.——The Mayor of Blackpool (Alderman Parkinson) has resigned the chairmanship of the Gas Committee of the Corporation, to the great regret of his colleagues.——The Sandwich Town Council have appointed Mr. W. Rogers, of Sittingbourne, as engineer in connection with their water-works.——The salary of Mr. C. R. Bellamy, the Gas Inspector and Superintendent of Street Lighting under the Liverpool Corporation, has been raised by £100 per annum. Mr. Bellamy's duties include the testing of gas and meters; and this substantial advance in his salary may be taken as an indication of the confidence reposed in him by the new Council.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 92.)

THE week just closed was got through on the Stock Exchange a great deal better than might fairly have been expected. Despite some little fluctuation and irregularity here and there, it is remarkable how calm and free from agitation the markets were (though a portion of the Press seemed to revel in trying to paint things as black as possible). Thus they displayed a combination of courage and caution which exerted a healthy influence. Prices in important departments exhibit a rise on balance. Consols are fractionally better, and rails made a nice advance, while several improvements were effected in the Foreign Market. The American, however, was depressed, owing to the unsatisfactory aspect of the new bond issue. The Money Market shows no feature indicating change. The Gas Market meanwhile has been fairly active. It presents no striking characteristic beyond the steady persistent demand for the high-class issues as investments. Some of the choicest of these have made further advances in value during the week, and those which have not advanced may be set down as very firm. Among the undertakings in more distant parts, there have been a few slight retrogressions; but these are mostly the result of local causes, and do not affect the general position. In Gaslights, a moderate amount of business was marked daily at remarkably steady figures; prices never ranging far above or below 297. There was a smart demand for the debenture and preference stocks, which readily realized excellent prices; and two of the number advanced their quotations. South Metropolitans were extremely quiet; and beyond one or two deals towards the end of the week, they were quite left alone. The prices marked, however, were well above middle figures. The demand for Commercials produced a further rise in quotation; but stock is very scarce. Transactions in the Suburban and Provincial Companies were more than usually limited, but not for lack of demand. Those most in request were conspicuously strong, especially Brentford old and Brighton "A." There was a fair amount of business done in the Continental division, which ruled very steady. Imperial was the most active; and prices in it were consistently nearer the top figure than the lower. The rest were for the most part unchanged; but those which did move were lower—viz., Buenos Ayres, Monte Video, and Hongkong. The Water Companies were very quiet, and not a single quotation was varied. The tendency, however, seemed to be rather favourable.

The daily operations were: Business in Gas on the opening day was pretty well restricted to the two biggest undertakings, and prices were fair. Gaslight preferences were strong; and the "K" rose 1. Monte Video fell ½. Tuesday was, to a great extent, the counterpart of the preceding day; but prices were a little better, though quotations did not rise. Wednesday was a quieter day at the old figures; quotations still remaining unchanged. Thursday was a little more active, and was strong. Commercial old advanced 2; and the buying price of Gaslight 4 per cent. debenture was raised two points. Hongkong receded ½. Transactions fell off on Friday in point of volume; and the only move was a rise of 3 in Brentford old. Saturday was unusually brisk; and prices were good generally, but Buenos Ayres relapsed ¼.

ELECTRIC LIGHTING MEMORANDA.

The "Electrician" Table of Electric Supply Stations in the United Kingdom.

IN the first number for the New Year, our contemporary the "Electrician" published its annual table of data relating to British central station electric lighting, which constitutes a store of, mainly technical, information likely to prove of some considerable use to those who may have occasion to refer to it. This publication dates from 1889, when the table was but a short one; and now it has attained to very respectable proportions. The entries are divided into two principal categories—namely, undertakings in London and in the Provinces. There is a supplementary list of establishments in progress; and, finally, a memorandum of projected stations. A few undertakings have not chosen to supply particulars of their doings for the instruction of the technical world; but the table is, on the whole, as comprehensive as it is in other respects carefully prepared. It appears that there are eighteen Metropolitan and Suburban central station undertakings in operation and in progress, of which the most important, occupying the best districts, belong to companies. The Provincial undertakings more or less in operation number 89; and if the same observation does not apply with precisely the same force to these, it does so to an extent. Of the seven installations listed as in progress, all but one—a small venture belonging to a firm at Llanelly—are classed as municipal. Of the projected establishments, moreover—that is to say, of ventures which are talked about as likely to "come off" at some time or other—only two are proposed by companies. Thus we are justified in writing of private electric lighting enterprise for this country as dead and buried. With regard to systems, in the newer completed and in the stations in progress, the alternating predominates; but in the established stations in London and throughout the country the continuous current keeps a good place. The largest concern of all is the Metropolitan Electric Supply Company, with its five generating stations serving the equivalent of 257,000 eight-candle lamps in its first-class district of 4·6 square miles in area. It may be stated at once that we do not ascribe perfect trustworthiness to the numbers expressing lamp connections in this table. They are doubtless given in good faith, and are somewhere near the mark; but one or two circumstances conspire to show that they should be taken with a considerable degree of reserve. This is natural enough, and one would expect on general grounds that, of all the data given in the table, these figures would be the least reliable. They are, for one thing, usually stated in fine, bold, round numbers—the London Electric Supply Corporation, for instance, claiming to supply 100,000 lamps—which scarcely need further comment. Then, again, the tale of lamps on circuit does not bear any rational proportion to the rated capacity of the generating plant. Thus the first undertaking in the table—the Charing Cross and Strand Electricity Supply Corporation—claims to have a lamp connection of 49,000 and a plant capacity of 36,000. Several other Metropolitan concerns are in the same case, which ignorance does not permit of our describing as happy or the reverse. Probably it is meant to signify the former, as we notice that the largest and presumably most prosperous of the provincial undertakings partake of the same condition; while the majority of them are differently circumstanced.

Some light is thrown upon these puzzling statistics by a foot-note to the table, which states that "by lamps connected is meant the aggregate maximum possible amperage of the houses connected, reduced to its equivalent in 8-c.p. lamps. By 'plant capacity' in 8-c.p. lamps is meant the aggregate number of 8-c.p. lamps which all the dynamos installed at the station could, if run simultaneously, supply *at the station terminals*." It is not, of course, for us to prescribe to our electric lighting friends the form in which they ought to cast their station and supply statistics. They are all very scientific persons, and may be supposed to know what is best for them and their industry in this regard. Indeed, our contemporary, in commending its table to the confidence of the public, remarks that "the scientific habit which characterizes the electrical industry above all others is exhibited in nothing more strikingly than in the penchant [*sic*] for a systematized knowledge of what is being done around them displayed by members of the electrical profession." After this modest claim, the followers and friends of other industries ought perhaps to "lie low and say nuffen," like Brer Rabbit. But, really, is the claim justified by the history of the "electrical profession," and borne out by the figures now in question? We cannot get the tradition of "French measurement" out of our recollection; and we should be surprised to hear that arc lamps are no longer rated as being of 2000 candle power in any part of the kingdom, and that incandescent electric lamps always yield their nominal illuminating power.

To return to the lamp and plant statistics of the table, however, and their interpretation, can it be seriously pretended that there is any value whatever in figures compiled upon such bases? If we were to prepare a statement of the actual condition of the gas industry of the United Kingdom, and were to insert as information worthy of respect a computation of the maximum producing power of the gas-works at the outlet of the foul main, with every retort in action at its full nominal capacity, and were to publish this alongside of an estimate of burner connections calculated upon the basis of the utmost working capacity of the consumers' meters fixed, what would be said of such an effort? But perchance we read our contemporary's claim wrongly. Perhaps the phraseology should be construed literally, to mean that members of the "electrical profession" have a *penchant* for knowing "what is being done around them," which does not extend to commuicating what they are doing themselves in exact terms for the instruction of a not always sympathetic world. All the same, it would be rather interesting to know, if only in the roundest of round numbers, how many incandescent electric lamps the British central stations actually have connected up in circuit, and how many the different stations could supply, whether regularly or at a pinch. Otherwise, it is difficult to perceive the value of collections of station statistics, which do not reveal this information. It may be nice to know that a certain station proudly possesses so many boilers and engines and dynamos. But there is no logical relationship to be made out between these data, by which a student of station equipment might be guided to an idea as to what constitutes good practice.

The most interesting feature of the table, after all, is the great variety it discloses in the principles of generating current and treating it as a commodity for distribution and sale. There appears to be a wide range of selection in every element of central station equipment, from the boiler to the consumers' meters; and the moral of the whole tableau is that, while you can obtain your current by all sorts of means, you can only hope to get from 5d. to 9d. per unit for it, according to circumstances over which the character of the generating plant cannot possibly exercise more than an insignificant degree of control.

IN THE CAUSE OF GOOD GOVERNMENT.

According to a definition as true as it is witty, a University is a place where they teach useless knowledge. No University is likely to suffer in public estimation by pleading guilty to this "soft impeachment." Of one University especially—that of Edinburgh—it is, moreover, notorious that the students are free to acquire as much or as little of the branches of learning professed by the occupants of the University chairs as they please. That is to say, they are largely dependent upon themselves for the good they get out of the University, which is perhaps one of the principal reasons why so many of them come to eminence in later life. Not the least of the services rendered by a Scottish University to the world has no connection with its professoriate or *curriculum*, but is an outcome of a traditional and quite illogical arrangement whereby the University provides itself with an ornamental head (who is called the Lord Rector) from the outer world. In pursuance of this custom, the Scottish Universities have distinguished themselves in time past by choosing for their Lords Rectors the most prominent men of thought or of action of the period; and as the sole duty which the recipient of this honour is expected to perform during his period of office is the delivery of an address *urbe et orbi*, English literature has been enriched from time to time with some of the finest orations in the language, occasioned in this way. Among all these treasures, a high place will be assigned to the address delivered last month in Edinburgh by Lord Justice-General Robertson, who took for his subject "The Duty of Educated Intellect to the State"—a luminous title, constituting almost an oration in itself.

We claim the right of introducing this rectorial address to our readers, because it goes straight to the point of many of our own essays and articles which have had the burden of showing that many of the troubles of modern communities—labour troubles, troubles among local authorities, and so forth—arise from, and are aggravated by, the abandonment of the field of practical politics by the proper leaders of the people, in favour of ignorant demagogues and agitators. Over and over again we have pointed out that, in political, industrial, and social strife under modern conditions, the weapons are for the hands that will use them; so that if the best men in a community will not have anything to do with them, others will, and will make the shirkers pay the expenses as well. It came last year as a welcome rift in a very gloomy outlook, when so many British municipalities invited peers of the realm and distinguished persons to accept the worshipful office of Mayor; because this new and striking policy might be interpreted as an indication that the most unlovely creation of Transatlantic municipal institutions—the ward politician—was henceforward to be forestalled in English local government. It is absolutely necessary, if our local governments are to be preserved from the disgrace that has overtaken similar organizations elsewhere, that the localities should in their degree be able to command the services in this regard of the best of the inhabitants, and of those who on any account are esteemed as the natural leaders of the communities with which they are connected by residence or otherwise. Experience abundantly shows that no constitutional or statutory safeguards that the wit of man has been able to devise will avail to ensure efficient government, whether it be of an empire or a village, in the absence from authority of the proper persons to understand and rightly perform its duties. It is unquestionable that of late years the responsibilities of local government have in this country, as in others, shifted from the natural heads of the communities to others who have shown greater willingness to assume them. In some places, the movement has been more noticeable than in others; and where it has gone farthest it would be a sanguine hope that a restoration to a better state of things will be easily or quickly effected. All the same, we are loth to believe that the case of the most deeply vulgarized, demagogue-ridden British local authority is utterly hopeless.

If our municipalities are to be redeemed, however, something more must be done for and by them than the occasional catching of a notable for Mayor. Peers and Privy Councillors may not always be available for lending an air of distinction to the mayoral position. But there is another way of doing the same thing; and that is, by making municipal office the training for, and stepping-stone to, wider honours and more onerous public positions. Peers are scarce in the municipal market, though they may become more plentiful. But where titled personages do not occur, there may be no lack of educated and cultured people who should be more ready to help local authorities in their work, instead of standing aloof and criticizing them, as they have hitherto preferred to do. This is the burden of Lord Justice-General Robertson's address.

The Lord Rector began by exhorting his young hearers—almost in the words of his predecessor in office, Carlyle—to "get wisdom." By this the speaker gave it to be understood that he did not mean merely professional skill, nor scientific knowledge, nor literary accomplishment, though all these are instrumental; nor did he mean natural shrewdness, or mother-wit. No; it was the quality that comes of liberal studies, the character of a fair mind enriched by culture. "It is the balanced mind, the candid disposition, the educated view, that perceives the relations of things, that is alive to analogies and not innocent of irony, that does not expect to find all things in categories, and all black or white, that is reverent to what is great and disaffected to what is smug. Not in mental acquisition, but in mental habit, is wisdom found." Such wisdom is not reserved for those of shining parts or great erudition. Very moderate powers, if they include that of taking pains, will suffice to furnish and illumine the mind; "and to some, who are very far from being deeply learned, there comes that feeling for what is sound and strong and fine, in literature and in thought, which enfranchises them as citizens" of the world-wide republic of the wise. And then, when this quality has been attained to, the question is, what to do with it. So far as the individual value of culture is concerned, the rectorial counsel is silent. It prefers to deal wholly with the public value and public duties of disciplined intellect. "The extent and complexity of public affairs are such as to demand the clearest and most reverent insight on the part of those who offer to handle them." To this vast fabric "the practical man whips him out and gaily applies the foot-rule of his personal experience." Still, it is as true now as in the days of Bacon, that "while expert men can execute and perhaps judge of particulars, one by one," yet "the general counsels and the plots and the marshalling of affairs come best from those that are learned. This is permanent and universal: "In proportion as the mind of a country is driven away, or withdraws, from interesting itself in the State and serving the State, that country is weakened, and human progress is stunted." While no one denies in set terms that the rulers of a people should be cultured, it is commonly said that "for the practical affairs of life, and particularly of politics, education is apt to bring a certain detachment from the interests and sympathies of common people;" and those who possess it constitute a separate class. This is admittedly true in part, and should be remembered by way of admonition. Yet, the Lord Rector profoundly observes, true culture has no more striking characteristic than that of not overrating education itself. It is only the half-educated person who magnifies the value of education, commonly so called. "Individual education—the education of school, or of school and college combined—is strong. But other things are stronger—race, character, religion, sentiment, interest in the past, loyalty to persons, knowledge of the world, business capacity—above all, the vast accumulated funds of wisdom and guidance which are covered by the invidious name 'prejudice' and the august name of 'authority.' The appreciation of these elements, and especially of their due weight in a civilized community, is a sure criterion of cultivated intelligence." It is, indeed, coming to be a note of deficient cultivation to have an unintelligent and inordinate affection for education, and a vast disposition to fuss over its apparatus. This is the mental habit which appears most conspicuously in modern "Progressivism," or state of what has been cynically termed "clever-little-boyism" in national and municipal politics.

Culture, on the other hand, must take its share in government; not as a preponderating influence, but for what it is worth. Cultured persons are not to regard themselves as superior beings, eligible for isolation as a caste of guides, philosophers, and friends of the vulgar. Their place is not in isolation but in fusion. "To exercise a formal arbitrament is not the function in national life which in these days is appointed for the educated; it is in their quality of citizens that they must seek to influence events. The rule of the game now is that each man starts by having a vote. But it is no corollary of that rule that the able man shall have no more influence than the other. All start fair; but the law of Nature is that the best man has most say in the end." There is no stupid equality in the matter; "for freedom expels equality, which is merely prejudice with a red cap on." What is required, says the Lord Rector, is "that, in all available ways, the light of knowledge shall be turned on the path of this self-governing people, and the best aid given by the best minds. Every man's life has its patriotic side; and his responsibility is not lightened, but increased, by the degree of his mental equipment. There is due to the State a tribute, or excise, out of cultivated intellect; and at present I doubt if the State gets its due. I speak this because I have, as everyone in this country is bound to have, an immense desire for the success of the system of popular government now established among us. That success must depend upon the prevalence of reason in its counsels." The conclusion arrived at is that the people of England will be willing to be led by the best thought "provided only it get the offer of it." The Lord Rector will not for a moment accept the pessimistic view that the majority is composed of ignorant, poor, and selfish people who will overbear the men of light. The people will only run to the demagogue if their proper guides are absent from the post of duty. Give the demagogue a monopoly, and of course he will make headway. But why should he have this monopoly? This can only be when the educated intellect that should be serving the State shirks its responsibility in this regard.

The illusion of Socialism, which is the support of so many demagogues, will not long survive the touch of those who, like the Lord Rector, see in it an idea of "a State in which man shall live by bread alone; in which, once for all, the human soul shall be given in exchange for rations; a State of which slavery is not merely an institution but the corner-stone, and in which the gates of intellectual freedom are shut for ever on mankind." Yet he urges that educated people should inquire

why it is that such ideas attract the populace, if only because such a study "compels the thoughts to turn to that gaunt figure of Poverty whose shadow darkens the land, and must increase a man's desire to help, according to the measure of his powers, towards sound means of mitigation. It will suggest also, perhaps, that the limits of State action are set by no inflexible rule by one generation for another." We cannot reproduce these extracts *ad libitum;* but we have probably done enough to convince our readers that the Lord Rector of the University of Edinburgh is a power in the land, making for that end to which we would all contribute our best endeavours—the cause of good government.

GAS BILLS FOR 1896.

In accordance with our annual practice, we give a summary of the projected Private Bill Legislation for the ensuing session of Parliament relating to gas supply in the United Kingdom. There are twenty Bills in all; three only being for incorporating limited companies.

The Aldershot Gas and Water Bill is to enable the Company to raise new capital to the amount of £60,000, to bear a 7 per cent. ordinary or 5 per cent. preference dividend, with borrowing powers to the amount of one-fourth the new issue. Lands are to be acquired within two years, and a tramway of full gauge constructed within three years, connecting the Company's gas-works with the London and South-Western Railway near the Tongham Station on the Alton and Winchester branch line. The tramway is to be used exclusively for the carriage of materials; and the Aldershot Urban District Council are to have the use of it for their sewage-works purposes upon mutually agreed terms. The agreement made between the Company and the North Camp and Farnborough Gas Company, Limited, for the purchase of the latter undertaking is confirmed; and permission is sought for the conclusion of such an agreement with the Frimley and Farnborough Water Company. Provision is to be made for contributions by the Company to the funds of a workman's benefit society. Pipes may be removed from houses that have remained unoccupied for three months.

The Bexhill Water and Gas Bill is to enable the Company to raise £46,000 of new 7 per cent. capital, with usual borrowing powers. Additional lands, not exceeding ten acres in extent, are to be acquired; and the Company desire to be authorized to apply for an Electric Lighting Order or Licence.

The Bournemouth Gas and Water Bill is to enlarge the Company's district of supply, and to authorize the raising of £300,000 additional 7 per cent. capital, with the usual proportion of loan. The amount of existing capital is not stated in the preamble. Additional gas lands are to be acquired. The period of error in defective meters is to be limited; and power is desired for supplying gas-fittings. Discounts of not exceeding 10 per cent. for gas accounts are to be sanctioned; and prepayment may be demanded for gas supplied for short periods. The Company desire to be permitted to apply for electric lighting powers.

The British Gaslight Company (Norwich) Bill is to empower the Company to expend an additional sum of £100,000 upon the extension of their Norwich station, provided that not more than £60,000 of this amount is to be capital stock, to bear 5 per cent. dividend; the remainder to be borrowed on mortgage at not exceeding 4 per cent interest. Additional lands are to be acquired for gas-works purposes.

The Cheltenham Gas Bill is to enable the Company to consolidate their stocks upon a 5 per cent. basis, and to raise £100,000 of additional 5 per cent. stock, with borrowing powers to the extent of one-fourth of the whole. The existing capital amounts to £155,000, composed of £25,000 original 10 per cent. stock, £50,000 of 7½ per cent. stock, and £80,000 of 7 per cent. stock; with £17,500 debenture stock. It is proposed to make a railway to connect the Company's works with the Midland Railway, to be completed within five years. Additional lands are to be acquired; and a roadway is to be stopped up, subject to agreement with certain college authorities.

The Cheltenham Corporation Gas Bill is to empower the Corporation of Cheltenham to acquire the undertaking of the Cheltenham Gaslight and Coke Company at a price to be agreed upon or ascertained by arbitration under the Arbitration Act of 1889. The Bill contains the usual provisions for enabling the Corporation to carry on the gas undertaking. The statutory limitation of the price of gas within the parish of Cheltenham to 4s. and elsewhere to 5s. per 1000 cubic feet is to be repealed, the maximum price being made 3s. for all the district, for 16-candle gas tested by Sugg's "London" sixteen-candle argand No. 1 burner. Candles are to be used in testing the gas until some other method is adopted for London gas, when the same is to be applied in Cheltenham. It is provided that before commencing a test for illuminating power the gas shall have been burning for at least 15 minutes. No forfeiture is to be incurred for deficient illuminating power or excess of impurity when occasioned by unavoidable cause or accident; nor in the case of sulphur unless the excess shall amount to 2 grains upon the average of six consecutive week days, or 10 grains upon any one day. The maximum of impurity is to be 5 grains of ammonia or 20 grains of sulphur. Besides the amount of the purchase-money, the sum of £500,000 is to be borrowed for gas purposes. Balances of gas revenue, whenever and so long as the price of gas does not exceed 2s. 4d. per 1000 cubic feet, may be carried to the borough fund.

The Colwyn Bay and District Gas Bill is for incorporating with statutory powers a limited Company formed in 1883 under the name of the Colwyn Bay and District Gas and Lighting Company, for the purpose of supplying gas in the parishes of Llandrillo-yn-Rhos, Denbighshire, and Eirias in Carnarvonshire. The Company obtained a Provisional Order in 1884, when the share capital was limited to £8000, which is all paid up, and there is a mortgage debt of £2000. The capital is to be increased £28,000; whereof to £8000 is to be original 10 per cent. capital, and the remainder to be raised as 7 per cent. ordinary or 6 per cent. preference capital, with the usual borrowing powers. Additional lands for gas manufacturing purposes are to be acquired. The sliding-scale is asked for, with the initial price of 5s. per 1000 cubic feet for 15-candle gas. An interim dividend may be declared by the Directors out of the ascertained profits of the Company, provided that the amount of the authorized dividends for the year are not exceeded. Saving clauses are inserted for the protection of the Crown and the London and North-Western Railway.

The Cowes Gas Bill is to incorporate a Company originally formed under a deed of settlement in 1846. The present nominal share capital of the Company is £14,830, of which £13,430 is paid up, and there is no mortgage debt. The works are on leasehold land. The district of the Company is to include the parishes of Cowes and Northwood, in the Isle of Wight and the county of Southampton. The capital is to be fixed at £33,430, whereof £20,000 is to be new 7 per cent. capital, with the usual borrowing powers. It is proposed that no person shall be disqualified from becoming or continuing a Director of the Company by reason of his or any partner of his being or becoming interested in any contract with the Company either in his own behalf or as a member of any other company, corporation, local authority, or partnership; but no such person shall as a Director vote in respect of any question as to any such contract or the remuneration attached to any such office or place of trust or profit. Auditors need not be shareholders. Interim dividends may be declared by the Directors, provided that any half-yearly dividend so declared shall not exceed one-half of the amount of the standard dividend. The books of the Company are to be balanced on Dec. 31. Lands required for gas purposes are to be acquired compulsorily. Interest at the rate of 5 per cent. is to be allowed on all consumers' deposits. The initial price under the sliding-scale is put at 4s. 2d. per 1000 cubic feet, for 15-candle gas, subject to discounts if the Company think fit. Notices of discontinuance are to be sent in writing to the office. The Company may refuse to supply persons in debt for other property; and the period of error in defective meters is limited to the current quarter. Power is desired to erect workmen's cottages on a portion of the Company's land.

The Dublin Corporation Bill makes provision for the establishment of four additional testing-places for gas, and defines the kind of photometer to be employed for this purpose. The average of all the tests is to be taken as the illuminating power of the gas for the day. Other clauses define the duties of gas examiners. It is sought to make the standard price of gas charged by the Company for gas supplied within the city 3s. 4d. per 1000 cubic feet; and to repeal the clause in the Company's Act of 1883 fixing the standard price at 4s. 1d. accordingly. The Corporation seek to be heard before the Official Auditor certifies the Company's accounts; and for every failure of the Company to comply with the provisions of the Act, or the Referees appointed by the Board of Trade, a fine of £50 and £10 per day is to be levied.

The Guildford Gas Bill is to consolidate the existing capital of the Company, amounting to £49,996, into a uniform stock bearing 5 per cent. dividend. The existing stock is scheduled as being divided into eight issues, bearing dividends of 10, 7½, 7, and 5 per cent. respectively. There are among these two issues of preference shares, amounting to £4056, and bearing 5 per cent. maximum dividends. As from June 30 next, the capital will stand at £74,656, whereof the sum of £4056 will still be preference stock, bearing a fixed dividend of 5 per cent., and the remainder will be consolidated ordinary stock "bearing a fixed dividend" of 5 per cent., subject to the sliding-scale. The method of appointment of the new stock among the holders of old shares is set out in detail. Additional capital to the amount of £75,000 is desired, with borrowing powers in the proportion of one-third. The sliding-scale is asked for, with an initial price of 3s. 10d. per 1000 cubic feet for gas supplied within the limits of the Act of 1857, or within a radius of two miles from the works, and 4s. 4d. per 1000 cubic feet beyond. The alteration of the rate of dividend is upon the scale of ⅛ per cent. for a penny. It is desired to make a railway from the goods yard of the London and South-Western Railway to the gas-works, to be completed within five years. Additional gas lands are to be taken; and authority is sought to apply for electric lighting powers.

The Ilfracombe Gas Bill is to extend the Company's limits of supply to include the parishes of Morthoe, Berrynarbor, and Combmartin. The capital amounts to £18,375 paid up, and is to be converted into £25,924 of 5 per cent. stock, whereof

£17,190 is to be preference capital. More 5 per cent. capital, to the amount of £40,000, is required, with borrowing powers in the proportion of one-third. Additional gas lands are to be acquired, and the existing works discontinued within four years, and the site sold. Part of the foreshore of the Bristol Channel known as Hele Beach is to be reclaimed, and a quay constructed which may be used for passenger and goods traffic; the Company to have power to levy rates and dues for the use of the structure for such purposes. Power is sought for allowing discounts to consumers. Notices of discontinuance are to be in writing; and in default the consumer is to be liable to pay up to the next usual period for ascertaining the register of the meter. Permission is to be asked in reference to applications for electric lighting powers.

The Leamington Corporation Bill contains a part relating to the proposed acquisition by the Corporation of the undertaking of the Leamington Priors Gas Company, which is to be carried into effect any time within five years. The amount of the consideration is to be ascertained by arbitration under the Lands Clauses Acts.

The Matlock Bath Gas Bill is to authorize the Matlock Bath and Scarthin Nick Urban District Council to acquire the undertaking of the local (limited) Company, and to supply gas. The amount of the purchase-money is to be ascertained by arbitration. The authority will supply 18-candle gas at the maximum price of 4s. 6d. per 1000 cubic feet. Besides the amount of the purchase-money, the sum of £10,000 is to be borrowed for gas purposes.

The Newcastle-upon-Tyne and Gateshead Gas Bill is to authorize the acquisition of additional gas lands, the erection of new works, and the raising of £500,000 of new stock, bearing 5 per cent. preference dividend, with power to borrow £150,000 in addition.

The South Metropolitan Gas Bill provides that, as from Aug. 12 next, the existing stocks of the Company shall be converted into one and the same class of ordinary stock, bearing a uniform dividend of 4 per cent. The stock is to be issued in multiples of £5. The Company's debenture stock is also to be converted into a new debenture stock, bearing not less than 3 per cent. interest. New issues may be offered to consumers and employees of the Company at not less than the average market price; the purchase-money of stock sold under the Act to be paid within one month. The sliding-scale is to be modified to a rise or fall of 1s. per cent. for the half year, for 1d. alteration in the price of gas for such half year. When the total investments of the Company's employees under the profit-sharing scheme of 1889 shall reach £40,000 in ordinary stock, the Directors may, as and when they deem expedient, prepare a scheme for the purpose of enabling employees to elect one or more of their number, but not exceeding three, to take part with the Directors in the management of the Company. Such scheme must be submitted to the shareholders specially assembled, after due notice, for its consideration; and it must be thereafter sanctioned by the Board of Trade. It is to run for three years, and to be renewable by the same forms. To be eligible for election as employees' Director, a man must be, and have been for seven years, in the Company's service, and must hold £80 in the ordinary stock of the Company. A schedule contains regulations as to nominations by persons in the employ of the Company to transfer stock, &c., and concerning payments to representatives of deceased depositors.

The Whittington Gas Bill is for incorporating a Company formed in 1864 for the purpose of supplying the town of the same name and its neighbourhood, in Derbyshire. The capital is nominally £10,000, one-half of which is paid-up; and there is no mortgage debt. The limits of the Company are to be the parishes of Whittington and Brimington; and the undertaking is to be called the Whittington District Gas Company, with a share capital of £20,000, whereof £15,000 is to be new 7 per cent. capital, with the usual borrowing powers. The meetings are to be held at the Company's office in London. Directors are not to be disqualified by reason of being interested in contracts with the Company. Interim dividends may be declared by the Directors. Additional lands are to be acquired for gas manufacturing purposes. The sliding-scale is asked for, with 4s. per 1000 cubic feet as the initial price of 14-candle gas, subject to discounts. Notices of discontinuance are to be sent to the principal office of the Company. Authority is sought to refuse to supply persons in debt for other property; for limiting the period of error in defective meters; and for building workmen's cottages on the Company's land.

The Ystradyfodwg Urban District Council (Gas and Water) Bill is to authorize the District Council to acquire the undertaking of the Gas and Water Company, at a price to be determined by arbitration, subject to certain provisions. Additional gas lands to the extent of 5 acres are required; and a scale of discounts is proposed for gas-rental accounts.

Gas from Sawdust.—According to the "Engineering and Mining Journal," the little town of Deseronto, in Canada, where there are several large lumber mills, is partially lighted with gas made from sawdust. It is reported to have an illuminating power of 18 candles; but, of course, resinous woods produce the best quality. The retorting of 100 kilos. of sawdust is stated to leave a residue of 20 kilos. of charcoal.

SIR JULIAN GOLDSMID.

It is with deep regret that we announce the death, on Tuesday last, at Brighton, after some weeks' illness, of the Right Hon. Sir Julian Goldsmid, Bart., M.P., who until quite recently was the Chairman of the Imperial Continental Gas Association. Sir Julian was the head of the first family of conforming Jews which rose to eminence in England, whither they came from Holland in 1765. He was the son of Mr. F. Goldsmid, M.P. for Honiton, and was born in 1838. He was educated privately up to the age of seventeen, when he entered University College, of which he was a prizeman, and took his degrees with high classical honours at the London University. In 1864, he was elected a Fellow of his College, and was called to the Bar by Lincoln's Inn. Last year he was made Vice-Chancellor of his University. He went the Oxford circuit; but being elected in 1866 to represent Honiton, he gave up practice as a barrister. In 1878, he succeeded to the family honours and estates in Sussex, Kent, Berks, and elsewhere. When Honiton was disfranchised by the Reform Bill of 1867, he stood unsuccessfully for Mid-Surrey; but he was returned for Rochester, and sat for that constituency till 1880. He was defeated at Sandwich; but in 1885 he was returned for South St. Pancras. He was always a Liberal, and was a firm supporter of Mr. Gladstone till the abandonment by that statesman of the principle of the unity of the Empire. As the Liberal Unionist candidate for South St. Pancras, Sir Julian was returned last year by an overwhelming majority (2433 votes against 1223 polled by his Radical opponent), although, owing to the state of his health, he was unable to meet the electors. At last Wednesday's meeting of the St. Pancras Vestry, a vote of condolence with the family was passed. Sir Julian showed great boldness and promptitude in using his extensive knowledge of the rules of Parliament in 1894, when he often presided over the deliberations of the House as Deputy-Chairman of Committees. However, during last year the claims of health compelled him to lessen rather than increase his responsibilities; and he retired from the presidency of the Anglo-Jewish Association, which he had held for ten years, and diminished his engagements in the City. As our readers will remember, one of the most important positions he relinquished on this account was the chairmanship of the Imperial Continental Gas Association, which he had held for twenty-one years—succeeding Mr. Twells in the office. In taking his farewell of the proprietors at the half-yearly meeting last November, he explained that he had had a serious illness which had very much incapacitated him for work—in fact, for any occupation. He had always felt that, if there was anything important going on, he must be there. He related how, when negotiations were pending for contracts and other matters, he would rush off, at a moment's notice, and travel sometimes for forty-eight hours continuously in order to attend to the business. All this, he added, he could do no longer; and, under the circumstances, the only course that remained for him was to leave the work in more capable hands. A resolution was passed expressing the shareholders' sincere regret at the announcement made by Sir Julian, and cordially thanking him for his great services to the Association in the past. Besides the Imperial Continental Gas Association, of which he had been a Director for nearly twenty-eight years, Sir Julian was a Director of the Continental Union Gas Company (and Chairman after the death of Mr. H. M'Lauchlan Backler), and was largely interested in several other gas undertakings, as well as in the London, Brighton, and South Coast Railway Company. He was Deputy-Lieutenant for Kent, Sussex, and Berkshire; a Magistrate for Kent, Sussex, and London; and Colonel of the 1st Sussex Rifle Volunteers. Quite recently he received the honour of being made a member of the Privy Council. Sir Julian married in 1868 Virginia, daughter of Mr. Philipson, of Florence, who died in 1892; and he had eight daughters. The funeral took place last Friday in the burial-ground of the British Jews of the Upper Berkeley Street Congregation, at Stoke Newington; representatives of the Imperial Continental Gas Association, and of the various other bodies with which Sir Julian Goldsmid was connected, being present.

Last Wednesday, "The Times" devoted the opening portion of a leading article to a notice of Sir Julian Goldsmid's worth as a politician, which it may not be out of place to reproduce here: "The death of Sir Julian Goldsmid makes an addition to the somewhat lengthy list of Parliamentary vacancies. It also creates a noticeable gap in the ranks of the Liberal Unionist party in the House of Commons. Sir Julian Goldsmid was not a frequent speaker, and never produced any great impression in debate; but, like many of the ablest members of Parliament, his capacity as a man of business was thoroughly appreciated by his colleagues. No one was better acquainted with the rules of the House, or was able to turn his knowledge to better account. No one was more useful in the conduct of that immense mass of important business which is transacted in the Committee-rooms, where his legal training and experience at the Bar, as well as his interest in large commercial and industrial enterprises, combined to give him weight and authority. When the 'Chairmen's Panel' was constituted, under the new system of procedure, Sir Julian Goldsmid soon became known as the most competent, prompt, and decided of all the Deputy-Chairmen. If his physical strength had permitted him to be a candidate, and if his wealth and position had

not removed the temptation from him, Sir Julian Goldsmid would have made an admirable Chairman of Committees, if not Speaker. It was known for some time that he was in failing health. But he had quite recently declared that he had no intention of resigning his seat; and consequently the choice of his successor, as the representative of the Unionists of South St. Pancras, remains to be determined."

POTABLE WATER.*

THE little book which M. Coreil has published under the above title is one of the series constituting the "Encyclopédie de Chimie Industrielle;" and the special merit claimed for it by the author is that it deals, in a manner at once concise and complete, with a subject which has hitherto been considered from various points of view. His aim has been to summarize and condense all the particulars which are now scattered over a number of pamphlets and other works, and to present them all together to the inquirer. His work is not, however, by any means of the "scissors and paste" character. As the chief of the Municipal Laboratory of Toulon, M. Coreil has had excellent opportunities of making independent experiments; and the results of these are included in the volume. His laboratory practice enables him to offer a few useful observations to those who are not familiar with the delicate and complex subject of the study of water. Up till within comparatively recent times, it was the analytical chemist, and he alone, who was called upon to determine the real value of a potable water. Now, however, the bacteriologist has given additional importance to, and thrown more light upon, this subject by his valuable investigations. At the present time, the water analyst must not be a chemist only, but a microscopist and a biologist. This branch of the subject is therefore amply treated by M. Coreil. The processes for improving and purifying water, which have received a great deal of attention of late years, with the view of bringing them nearer perfection, are described. The volume is divided into five parts. In the first, the author examines the various elements of potable water, and its relation to disease; in the second, he deals with chemical analysis; in the third, with the microscopic examination of water; in the fourth, with its bacteriological and biological examination; and in the last, he reviews the best-known processes for improving the condition of water. From this brief summary of the contents of M. Coreil's book, it will be gathered that the author addresses himself to medical men, pharmacists, chemists, and hygienists. The text, which occupies 346 pages, is freely illustrated; and there is a good index.

THE GAS UNDERTAKINGS RETURNS.

THE returns relating to the gas undertakings of the United Kingdom for the year ending Dec. 31, 1894, in the case of the Companies, and March 25, 1895, in that of the Local Authorities—were issued during the past week, pursuant to an order of the House of Commons dated the 4th of September last. This is an improvement upon last year, when the returns, though ordered on Aug. 15, 1894, did not make their appearance till the middle of February. We give below the principal figures.

The returns furnish particulars in regard to 428 authorized gas undertakings in the hands of Companies—being the same number as before. Two of the Companies are in Scotland, and nine in Ireland. With regard to the Local Authorities, particulars in reference to their gas undertakings were supplied by 199, as compared with 192 in the preceding year; the seven newcomers being Abertillery, Barnoldswick, Barry, Goole, Kendal, Wokingham, and Falkirk. Of the total, 36 are in Scotland, and 6 in Ireland. The additional Scotch undertaking which appears—viz., Falkirk—was only acquired by the Commissioners in February last, and consequently no particulars as to working can be given. In the case of Barry, the return is for fifteen months; in that of Goole, for nine months; and in that of Wokingham, for six months. The total amount of capital authorized for the 627 gas undertakings is £83,651,983, of which £69,423,431 has been paid up and borrowed. The previous amounts were £82,501,648 10s. and £67,655,207 10s. The receipts on revenue account are £19,408,265, as compared with £18,829,305; and the expenditure is £13,791,520, against £14,095,218. Turning to the statistics of working, the quantity of coal and cannel carbonized in the period covered by the returns was 11,319,301 tons; the bulk of gas produced being 114,295,680,640 cubic feet, of which 105,160,990,259 cubic feet were sold. The previous totals were: Coals, 11,020,292 tons; gas made, 110,781,788,401 cubic feet; gas sold, 101,886,371,130 cubic feet. At the dates to which the last returns were made up, there were 23,310 miles of mains in use for the supply of 2,524,217 consumers and 512,856 public lamps. The previous figures were: Miles of mains, 22,826½; consumers, 2,451,585; public lamps, 507,226. The returns, as a rule, are made up to the dates named above; but where other periods have been taken, the fact is indicated. In a few instances, precise information cannot be given as to the make of gas, the consumption for public lighting, and the length of mains; but mostly the particulars required by Parliament are furnished. The amount of capital authorized for gas undertakings in the hands of both Companies and Local Authorities includes, in some instances, other purposes.

Comparing the foregoing figures with similar returns for the previous nine years, it will be seen that the capital obligations of the Companies are as follows:—

Year.	Share and Premium Capital Paid up.	Loan Capital Issued.	Capital Sold under Auction Clauses.	Premiums Realized.
1885. . .	£30,109,429	£5,404,141	£3,088,460	£1,306,238
1886. . .	30,960,026	5,679,830	3,209,564	1,393,773
1887. . .	31,556,788	5,839,792	3,354,093	1,473,636
1888. . .	31,736,024	6,002,510	3,488,588	1,517,902
1889. . .	32,117,202	6,090,546	3,641,730	1,563,595
1890. . .	32,884,026	6,568,676	4,008,465	1,765,557
1891. . .	34,282,164½	6,862,117	4,300,266	1,823,068
1892. . .	35,266,898½	7,149,367	4,755,597	2,144,619
1893. . .	36,491,562½	7,544,563	5,417,667	2,432,970
1894. . .	37,059,199½	7,739,678	5,715,024	2,637,019

Some of the other comparative details in the Companies' returns are—

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1885. . .	5,595,371	56,903,060,785	1,115,223	250,404
1886. . .	5,777,966	59,051,111,814	1,133,897	258,072
1887. . .	5,977,254	61,266,055,857	1,152,119	264,316
1888. . .	6,050,588	62,328,542,470	1,103,198	259,921
1889. . .	6,309,495	64,627,914,489	1,128,838	268,013
1890. . .	6,618,460	67,214,546,500	1,153,989	275,611
1891. . .	7,071,161	70,953,927,023	1,180,333	282,761
1892. . .	7,119,189	72,178,028,396	1,213,322	288,021
1893. . .	6,995,125	71,050,955,154	1,225,253	296,910
1894. . .	7,128,126	72,610,842,498	1,266,943	295,787

The somewhat similar figures for the Local Authorities are—

Year.	Amount Borrowed, including Annuities (not deducting Repayments).	Receipts.	Expenditure (exclusive of Amount in the next Column).	Interest, &c., Paid.*	Net Profit after Payment of Items in preceding Column.
1885-6 .	£19,619,416	£4,348,105	£3,117,989	£901,773	£355,469
1886-7 .	19,723,046	4,403,262	3,127,047	951,636	359,532
1887-8 .	20,081,435	4,495,093	3,161,604	923,157	439,467
1888-9 .	21,333,833	4,817,269	3,375,197	977,154	479,489
1889-90 .	21,669,789	5,067,843	3,627,578	971,755	486,483
1890-91 .	21,891,655	5,628,212	4,231,643	956,183	460,608
1891-92 .	22,476,180	5,906,319	4,589,109	965,533	397,947
1892-93 .	22,734,556	5,983,359	4,702,179	994,517	305,040
1893-94 .	23,619,082	6,219,460	4,866,486	1,038,462	341,470
1894-95 .	24,624,554	6,402,046	4,681,035	1,114,014	622,366

* These figures include: (1) Interest paid on loans; (2) amount paid for annuities (3) amount of loans repaid; (4) amount paid for redemption of annuities (5) amount placed to sinking fund.

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1885-6 . .	2,783,533	27,734,666,850	979,802	151,670
1886-7 . .	2,879,765	28,880,425,240	996,480	155,849
1887-8 . .	2,985,577	30,105,457,962	1,011,139	159,264
1888-9 . .	3,204,982	32,381,124,770	1,089,748	174,191
1889-90 . .	3,353,516	33,453,368,830	1,115,267	178,867
1890-91 . .	3,623,967	35,796,491,799	1,143,289	184,773
1891-92 . .	4,148,131	37,740,332,448	1,172,704	192,323
1892-93 . .	3,977,291	39,303,250,095	1,203,574	201,484
1893-94 . .	4,025,167	39,730,833,247	1,226,332	210,316
1894-95 . .	4,191,175	41,684,838,142	1,257,274	217,069

Received.—"The Local Government Annual and Official Directory, 1896;" "The Local Government Act, 1894." (London: S. Edgecumbe Rogers.) This is the fifth year of publication of the first-named work, which has been much improved by the Editor (Mr. S. E. Rogers). Officials and members of public bodies will find a good deal of information therein compressed into a small space. The other work is the fourth edition of a pamphlet containing an abstract of the clauses of the Parish and District Councils Act, with an index and an explanatory.

Gas Companies and the Sale of Stoves.—The "British Trade Journal" for the 1st inst. contained an editorial "Note" calling attention to the practice of gas companies allowing a much larger discount to buyers of stoves from them than that which could be obtained, even if any were given, from the ordinary makers. This question has already been discussed in our "Correspondence" columns; but we do not think one phase of it, referred to by our contemporary, was then brought out—viz., that gas-stoves are obtained from gas companies on the favourable terms granted by them, not, however, for the consumption of their gas, but for resale and even for shipment. Gas suppliers as well as stove makers might look into this.

* "L'Eau Potable." Par F. Coreil, Directeur du Laboratoire Municipal de Toulon. Avec 135 figures. Paris: J. B. Baillière et Fils; 1896.

NOTES.

A Gas-Driven Crane.

The Paris Gas Company have fitted up at their Clichy station a crane driven by a gas-engine for unloading the barges coming alongside the works. Facilities are afforded there for delivering into the stores 100,000 tons of coal annually; and up till recently the work of discharging the barges was performed by three steam-cranes, which raised 450 tons a day at a not very considerable speed. The new crane is more powerful than the others, and consequently it does a greater quantity of work. In deciding upon its erection, two objects were kept in view—viz., safety of the workmen and economy of working; and both have been secured. The attendant operating the crane is stationed in a capacious glazed shed, from which the barge and the coal-waggon are equally well seen. Here is the first piece of economy, for the services of the look-out man usually in position are not needed; and the second may be found in the fact that no one is required to oil the engine—what little attention in this way is necessary being given by the attendant during the intervals of changing the barges. However, for the sake of safety, it is thought advisable to have a second man in the shed. The crane works on a pivot. Its neck is nearly 25 feet long; and it is counterbalanced by a weight of about 2 tons. It has to lift 25 cwt. of coal in a skip weighing 10 cwt.—35 cwt. in all—to a height of 69 feet; and it does this at the rate of 20 inches per second. The engine is of the horizontal type, with two cylinders, each of 9 inches diameter and 16-inch stroke. The power developed, at a speed of 140 revolutions per minute, is 16-horse. Cooling water is supplied at the rate of 4½ gallons per horse-power-hour. The principal advantages claimed for the crane may be summed up as follows: Lower first cost as compared with the steam-cranes displaced; economy of labour; and small consumption of gas per ton of coal raised. But to these should be added the important consideration that work is not likely to be stopped in winter by the freezing of boilers or steam-pipes during the night. The installation of the crane in any part of the works is a very simple matter, inasmuch as all that is required is to lay on a supply of gas and water, both of which are generally to be found conveniently near. A view of the crane is given in the number of the "Journal des Usines à Gaz" for Dec. 20.

Gas and Steam Pipe Tables.

Messrs. Edwin Lewis and Sons, of Wolverhampton, have forwarded to us specimen copies of two new tables of weights and measurements of wrought-iron gas and steam tubes, prepared and issued by them for the use of the trade. These tables are well adapted to serve the purpose of informing engineers and draughtsmen of the facts as to the lengths and other stock measurements of all sizes of wrought-iron tube fittings; thus saving considerable trouble in planning. Copies of the tables can be had on application by professional men and the trade. The table of gas-piping begins with ¼-inch pipe, and extends to 6-inch pipe. The fittings included in the list comprise the round bend, round and square elbows, the cross, tee, socket, flange, and nipple, in all sizes. The table of steam-tubing is similar in every respect. The attention of architects in particular should be attracted to data of this kind, as helping to establish the habit of greater precision in specifications of internal gas-fittings. These are the only lists we know of which give, among other particulars, the actual outside measurements of every tube fitting generally used.

The Kane-Pennington Motor.

Further information respecting the Kane-Pennington gas or vapour engine, which is just now attracting much attention by reason of the reported peculiarities of its method of working, has been published by the "American Machinist," on the authority of Mr. Randol, who has examined several motors of the kind applied to the driving of road carriages. In this motor, the charge of gas or vapour is treated by two electric sparks; the first being passed through the mixture in the cylinder, the latter igniting it. Mr. Randol asserts that, as a result of this treatment of the charge, the great heat which in other internal combustion engines manifests itself as an inconvenient bye-product, is in the Pennington engine transformed into useful effect on the piston. He asserts from his own knowledge that when the first, or "mingling," spark, as Mr. Pennington terms it, is not put through the charge, the engine becomes weak and hot; while when it is used, a common gas-engine gives twice its ordinary effect on the crank. It is stated that every expert who has examined the engine supports this conclusion. This two-spark mechanism of the Pennington motor actually does not cost 5c.; and yet when applied to the Regan gas-engine, largely built, up to the present time, by the Kane establishment at Racine, it is reported to double the power of this motor. The consumption of common kerosene oil per hour per horse power indicated in the Kane-Pennington motor is about one-tenth of a gallon. A 2-horse power motor made for a road carriage weighs 17½ lbs. The cylinder proportions of the engine are not at all in accordance with ordinary gas-engine practice; 2½ inch cylinders with 6 inch stroke being the standard Kane-Pennington unit. A still wider departure is shown in a new engine which has a 2½ in. by 12 in. cylinder, in which the terminal pressure is reduced almost to the atmospheric, with a fuel economy of about 45 per cent. over previous performances. The engine appears to be of extremely simple construction. The cylinders are made of drawn steel tubes, with trunk pistons. The one great mystery is the coolness of the naked cylinders, which according to common experience should be red hot after twenty strokes or so.

Some Views of Acetylene.

In discussing the past year's progress in chemistry, the "Engineer" remarks on the synthetical results promised from calcium carbide, that the chemical production of food-stuffs is not yet, nor is it especially to be desired so long as plants continue to store diffused solar energy with a degree of economy that cannot be approached by other means. An illustration of the doubtful utility of seeking to produce a substance which is yielded by a natural organized material is afforded by the endeavour to prepare alcohol from chalk, coal, and water. Calcium carbide, which provides the point of departure for this operation, is formed by the interaction of lime and carbon at an extremely high temperature, and evolves acetylene on the addition of water, whence the building-up of the alcohol molecule can proceed by well-known steps. But "even with Niagara to help the synthesis, a field of barley and a few yeast cells may be safely backed to give the better output." Although acetylene from calcium carbide is regarded as unlikely to displace starch as a raw material for whisky, yet it is allowed to have a fair prospect of use as a lighting agent in cases where compactness or easy transport is desired. In this case, it is remarked, the electrician has materially helped a chemical industry; but an ill-return has been made by the chemist, who, by the aid of certain oxides, once stigmatized as "rare earths," and an atmospheric burner, is running electrical enterprise hard in the production of a light both good and cheap. Meanwhile, it is observed that the status of calcium carbide for transportation is not settled.

Effect of Temperature on Iron and Steel.

At a recent meeting of the American Society of Mechanical Engineers, Professor R. C. Carpenter presented a paper on the above subject, in which he gave the results of some experiments conducted in the spring of last year in the laboratory of the Sibley College. They afforded a confirmation of the fact discovered by earlier experimenters, that the strength of wrought iron and steel does not decrease, but on the contrary increases, with a rise of temperature up to about 500° Fahr., beyond which point the metals become plastic, and will flow under almost any strain. In certain respects, however, Professor Carpenter's results do not accord with those of other investigators. Mr. J. E. Howard found a few years ago that the tensile strength of steel diminishes as the temperature increases from zero until a minimum is reached between 200° and 300° Fahr.; the total decrease being about 4000 lbs. per square inch in the softer steels, and from 6000 lbs. to 8000 lbs. in steels of over 80,000 lbs. tensile strength. From this minimum, he found the strength to increase up to 400° to 650° Fahr.; the maximum being reached earlier in the harder steels, and the increase amounting to from 10,000 lbs. to 20,000 lbs. per square inch above the minimum strength at from 200° to 300° Fahr.

A Meteorologist on the Metric System.

In view of the attempt recently made to obtain Government assistance for the enterprise of forcibly imposing the metric system of weights and measures upon the United Kingdom, it is worth recording that Professor H. A. Hazen, of Washington, has been writing to "Nature" denouncing the metric system for meteorological and thermometric work. Professor Hazen has no particular objection to the substitution of the metre for the yard measure, for those applications to which a unit of this dimension has been found convenient in practice. He thinks, indeed, it was a great pity that the French, in looking for a convenient length to divide into 1000 parts, did not take up the already existing yard, which is so nearly the same as the metre, whereby an incalculable amount of confusion would have been saved. In meterology, 0·01 inch of air pressure is an extremely convenient limit; and in most inquiries of the kind only two figures are needed. On the other hand, a millimetre (0·04 in.) is altogether too large a limit; and one-tenth of a millimetre is too small. The labour of writing, averaging, and studying with the metric scale would be at least one-third greater than with the common scale to the same degree of accuracy. The metric system usually carries with it the centigrade scale on the thermometer. Here again, Professor Hazen calls upon the whole English-speaking world to give forth no uncertain sound; because in meteorology it would be difficult to find a worse scale than the centigrade. The centigrade degree is just twice too large for ordinary studies; and a worse difficulty is in the occurrence of the *minus* sign with all measurements below freezing. Professor Hazen hopes that anyone who desires to make the change on general principles will try writing down a column of thirty figures half below 32° Fahr., then convert them to the centigrade scale, and try to average them. It is suggested as infinitely preferable that a thermometric scale should be agreed upon by meteorologists having a zero at — 40° both Fahrenheit and centigrade.

TECHNICAL RECORD.

THE BRITISH ASSOCIATION OF WATER ENGINEERS.

On Saturday last, a representative body of water engineers, numbering nearly 40, assembled at the Exchange Hall, Nottingham, by the kind permission of the Mayor, to consider the question of furthering the scheme proposed by Mr. D. M. F. Gaskin, M.Inst.C.E., for forming an Association of Water-Works Engineers. In his proposal, Mr. Gaskin (who is the Engineer of the Nottingham Corporation Water-Works) has received the hearty co-operation of his Committee, the Chairman of which —Mr. Alderman Sands, J.P.—showed his interest in the movement by inviting the visitors to lunch with him at the place of meeting, and by personally conducting the first part of the proceedings; his experience being of material assistance in bringing what was unavoidably a somewhat discursive discussion on matters of detail to a successful issue. In addition to the gentlemen present, who came from all parts of the country, upwards of 50 others had informed Mr. Gaskin of their willingness to actively support the proposed organization.

After luncheon, the meeting was held in an adjoining room—Alderman SANDS presiding.

The CHAIRMAN, in opening the proceedings, said it was a privilege to him to meet and welcome to Nottingham a body of gentlemen assembled for the purpose of inaugurating what he believed would be one of the most successful societies of the day. Their presence there, and the fact that he had before him the names of 56 other gentlemen who, had time and opportunity permitted, would have attended, was a certain proof that the necessity existed for such an organization as he hoped they would found that day. It was singularly appropriate that this meeting should be held in Nottingham, because, as they were well aware, it was the birthplace of one of the first engineers whose attention was directed to water-works construction generally, and who might be looked upon as the father of water-works enterprise. He referred to the late Mr. Thomas Hawksley. He (Alderman Sands) hoped that on a future occasion, at some more genial season of the year, the Association would visit Nottingham, and see some of the work which Mr. Hawksley did for the borough. The works he erected for them (or rather for the Water Company originally) were of a character which they, as a Corporation, were proud to possess. He (the Chairman) had not been connected long with the Water Committee; but, during the time he had been, he had found it was one of the most interesting occupations that any member of the Corporation could be concerned in. They had had experience in the promotion and carrying out of extensions for the supply of water in the district; and it seemed to him that, in the supply of what was one of the first necessities of civilized countries, there was an almost unlimited scope for the ability of a large body of professional gentlemen. He thought that the body of intellect in this particular direction was possessed eminently in England; and he was sure that the enterprise and power of this country would keep them at the head of water engineering—at least he hoped so. At the same time, they were very willing to learn from their neighbours on the Continent and elsewhere what they were doing in this respect. He concluded by calling upon Mr. Gaskin to introduce the question of the formation of the Association.

Mr. GASKIN said they were trying to inaugurate a society which he felt would be of benefit not only to themselves as water engineers, but to the consumers. As those present were well aware, they were an isolated body—that was, compared with other branches of the profession, such as the gas and electrical engineers. He wished it to be clearly understood that they were not departing in any sense from the parent Institution in Great George Street. That Institution was one of the finest in the world; but there were questions which it could not take up that they as an Association could. There were many points which called for attention. For instance, there was the diversity of regulations between large towns, which was such as to be very conflicting to manufacturers, as well as to those who had to deal with them. That was a subject on which they might take combined action, and endeavour to get some equality in the regulations. A strong point was made in favour of an Association only a month or so ago. The Board of Trade issued a circular in reference to explosions of domestic boilers, and suggested that water companies and authorities should place before their customers a concise statement of the safeguards that should be adopted. The amount of diversity in the statements issued by the water authorities to the public in different districts had been very amusing. The matter was brought before a meeting of the Association of Municipal Corporations in London; and it was very properly decided by the members that it was not a question for them, but for engineers. If an Association of Water Engineers had been in existence, the Executive could have met and drawn up a statement which the Board of Trade would have been glad to have had as a guide for the future. Then, again, there had been a considerable amount of trouble in London in regard to 2 or 3 gallon flushing-cisterns. Now all water engineers—at any rate the majority of them—were in favour of the 2-gallon cistern; the 3-gallon cistern being practically confined to faddists. A 2-gallon cistern would give an ample flush if the work was properly done. This brought him to the subject of qualified plumbers; and they might combine to employ no one on water-works as a plumber without evidence as to his competency. Those were a few of the points that had struck him in bringing this matter forward; and now as to the objects of the proposed Association. The objects would be: (1) To promote the advancement of water-works engineering, management, and finance, and to facilitate the interchange of information among its members for the mutual benefit of water authorities and their consumers, and for the purpose of securing economy and unanimity in the carrying on of water-works. (2) The establishment and maintenance of a friendly spirit between the members by social intercourse, and by the exchange of information and ideas. (3) The inducement and extension of cordial and friendly relations between the members and their Committees or Directors, based upon the mutuality of interests and the recognition by both of the fact that each have rights which the other should respect. (4) To invite from members and others communications relating to water engineering and to matters relating to water undertakings. (5) To give the Legislature and public bodies and others facilities for conferring with, and ascertaining the views of, persons engaged or interested in water-works undertakings. (6) To confer with any other public bodies in regard to matters affecting water-works undertakings; to originate and promote improvements in the law, and to support the passing of alterations therein; to effect improvements in administration; and to improve and elevate the technical and general knowledge of persons engaged, or about to be engaged, in the profession of water-works engineers or managers. He then proposed—"That the British Association of Water-Works Engineers be now formed, and that the first members be composd of those present, and those who have signified their intention of becoming active supporters."

Mr. ISAAC CARR (Widnes) inquired the total number of favourable replies.

Mr. GASKIN: About 90.

Mr. A. F. BOWKER (Mid-Kent Water Company) seconded the motion.

A few questions on matters of detail having been put,

Mr. H. ASHTON HILL (South Staffordshire Water Company) suggested that the title of the Association and other details might be left to a Committee to settle.

Eventually, the motion was amended and adopted in the following form: "That an Association be formed to be called provisionally 'The British Association of Water Engineers,' to promote the objects mentioned by Mr. Gaskin in his opening statement."

Mr. CARR suggested that the meeting should next proceed to select a Provisional Committee to deal with matters of detail. It was, he said, impossible at a meeting of this kind to attend to all the necessary details as to the rules and regulations. The best they could hope to accomplish on the present occasion was to pick a body of gentlemen who were willing and competent to undertake to enter into the details attaching to the formation of the Association.

Mr. T. N. RITSON (Kendal) trusted that their first President would be Mr. Gaskin. He belived he was giving voice to the sentiments of all present in saying that that gentleman was to be congratulated most sincerely on the move he had made in introducing this Association. As to the necessity of such a society, he (Mr. Ritson) did not think there could be any doubt whatever. It had been felt for many years; and he ventured to say that, if the water authorities and consumers reaped anything like the same benefit by this Association as the gas authorities and consumers had done by the various Associations attached to the gas industry—more particularly The Gas Institute and the Institution of Gas Engineers—its formation would be more than justified.

Mr. W. MATTHEWS (Southampton) thought it would be a pity for them to attempt to go too fast in this matter. He came there that day largely with an open mind as to what was best to be done. He would admit that, if he had a tendency one way or the other, it was rather, on the first blush, as to whether such an Association was necessary; and it was only fair to say that he had been in communication on the subject with Sir Benjamin Baker, the President of the Institution of Civil Engineers, with the view of getting his ideas—recognizing that he was a broad-minded man. Sir Benjamin rather advocated delay, as, he said, no doubt the rules of the Institution would be altered somewhat upon the lines he suggested in his Presidential Address. As a matter of fact, he (Mr. Matthews) had, therefore, come to the meeting prepared to move an amendment that the consideration of the subject be deferred for the present, so that they might communicate with the Council of the Institution, asking them to take into early consideration the subject of holding sectional meetings. Then, with the views of the Council before them, they might later on discuss the desirability of forming such an Association as was proposed. But on arriving at the meeting, he saw such a representative body present, and there seemed to be so much unanimity, that he felt it would not have been proper for him, under the circumstances, to have moved an amendment; and so far, he might say, this had turned

the balance in favour of the starting of the Association. There were, however, many points which they ought to consider well before they rushed into the scheme. There was the point as to who should be members, and who should not—whether, for instance, they should introduce the class of mechanical engineers who were connected with the manufacture of pumping or other machinery used in water-works. To his mind, their opinions as manufacturers and designers would be of great benefit. If they confined themselves too much to themselves, they might get into a narrow spirit; and he therefore thought it desirable they should have, to a certain extent, somewhat of the outside element introduced into the Association. Take, he said, as an example, the discussions at the meetings of the Institution of Civil Engineers. There they had the benefit of the experience of engineers who were practising in very varied fields. Nobody could really say where one man's practice began, and where it ended; and there were times when one learnt a great deal that was applicable to his own particular line from a man who was working in a very different way. It would be unwise for them to eliminate from their discussions such experience as that to which he had referred. He was very anxious that the Association should be established on absolutely sound and solid lines, so that it might be beyond the breath of reproach, and be successful and useful.

The question of the appointment of a Committee to draw up a code of rules, and to generally consider the constitution of the Association, was fully discussed; among those taking part being Messrs. W. Watts (Oldham), W. A. Richardson (Birkenhead), C. H. Priestley (Cardiff), A. F. Bowker, H. Roberts (Ipswich), H. W. Pearson (Bristol), R. O. Wynne Roberts (Oswestry), C. Sainty (Eton), and W. Terry (Sheffield).

In the course of the discussion, two or three resolutions were proposed; but the two following, drafted by Mr. F. B. Harris, the Deputy Clerk of the Peace of Nottingham, were eventually adopted: "That a Provisional Committee be formed, to consider fully the constitution of the Association, the status and qualification of its members, and the necessary rules and regulations, and to report to a meeting of the promoters to be held at as early a date as possible;" and "that a Chairman of such Committee and a Provisional Committee be now elected."

On the motion of Mr. Ritson, seconded by Mr. Richardson, Mr. Gaskin was unanimously appointed Chairman of the Committee.

Mr. MacIntyre (London), who has already rendered Mr. Gaskin considerable assistance in the matter, was chosen Secretary of the Committee, on the proposition of Mr. Gaskin, seconded by Mr. T. Hughes (Wigan).

The following gentlemen were then selected to serve on the Committee, with power to add to their number: Messrs. Parry (Liverpool), Bowker, Ashton Hill, Richardson, Carr, Priestley, Mathews, Roberts, Woodward (Wolverhampton), Terry, Watts, Leggatt (Grand Junction Water Company), and Ware (Maidstone).

Votes of thanks were next passed to Alderman Sands for presiding and entertaining the visitors, and to the Deputy Clerk of the Peace for his assistance during the proceedings.

Alderman Sands at this stage vacated the chair, which was taken by Mr. Gaskin.

Mr. C. H. W. Biggs (London) then read a paper on "The Municipal Water Supply of Cologne," the information for which had been supplied by Herr C. P. Feldmann and Herr E. Froitzheim. The communication, which contained many points of interest, will be dealt with in a future issue.

A vote of thanks to Mr. Gaskin was subsequently passed, on the proposition of Mr. J. Wright, a member of the Nottingham Corporation Water Committee, seconded by Mr. Richardson. The members also acknowledged their indebtedness to the Mayor for granting them the use of the Hall for the meeting.

Before leaving (again by the generosity of Alderman Sands), the visitors were provided with tea.

The Management of the Sevenoaks Gas-Works.—Mr. William J. Dougall, third son of Mr. A. Dougall, Engineer at the Hull station of the British Gaslight Company, has been appointed Engineer and Manager of the Sevenoaks Gas-Works, in succession to Mr. A. Winter, who has resigned through ill-health. Mr. Dougall was trained as an engineer in the works of Messrs. Samuel Cutler and Sons, of Millwall; and he has latterly for several years been under his father at Hull.

Explosions of Domestic Boilers.—The Kent Water Company have complied with the request lately made to water authorities by the Board of Trade, and suggested to their consumers a few precautions which they deem expedient in the use of high-pressure boilers—of course, disclaiming all responsibility. They advise: "(1) That a safety-valve be fixed on every boiler which has not a loose moveable lid, and be frequently examined. (2) That every such boiler be supplied from a cistern of sufficient capacity for at least 24 hours' requirements. The law prohibits any direct communication between the pipes of the Company and any boiler. (3) That all such cisterns, and the pipes connected with any such boiler, be properly protected against frost. (4) That whenever the water supply in the cistern commanding the boiler becomes exhausted, and the boiler empty, or nearly so, the fire should be at once put out, and the boiler cooled before water is again admitted."

ON FLAME TEMPERATURES AND THE ACETYLENE THEORY OF LUMINOUS HYDROCARBON FLAMES.

By Arthur Smithells, B.Sc.,
Professor of Chemistry, Yorkshire College, Leeds.

[A Paper read before the Chemical Society, Nov. 7, 1895, and Reprinted from the Society's "Journal."]

In a paper read before the Chemical Society in 1892,* I gave a short summary of the evidence bearing upon the structure of luminous hydrocarbon flames, and endeavoured to account for the four distinctive parts of such flames which had been generally recognized by workers on this subject. Referring to the separation of solid particles of carbon, I said: "A problem remaining to be studied concerns the exact course of the decomposition of the hydrocarbon in the flame." Shortly after the above paper appeared, Professor Lewes read a paper before the Society,† in which he advanced the doctrine that the luminosity of flame depends on the intermediate formation of acetylene. He also adopted a new view as to the zones which constitute an ordinary luminous flame. In subsequent papers, Professor Lewes has developed his theory concerning the source of the luminosity in hydrocarbon flames. He recognizes three distinct parts in luminous flames: (1) "The inner zone, in which the temperature rises from a comparatively low point at the mouth of the burner to between 1000° and 1100° at the apex of the zone." In this zone, the most important action is the conversion of part of the hydrocarbons into acetylene (2) "The luminous zone, in which the temperature ranges from 1100° to a little over 1300°." Here the chief action is the decomposition into its elements of the acetylene formed in the preceding zone. (3) "The extreme outer zone, in which the cooling and diluting influence of the entering air renders a thin layer non-luminous, and finally extinguishes it."

In advancing this view, Professor Lewes omits all notice of the detailed experimental evidence by which I was led to endorse and amplify the older view as to the distinctive parts of a flame. I do not feel it necessary at present, therefore, to say more as to the latter, but will confine myself to a categorical consideration of the evidence on which the acetylene theory is based.

The Temperature Gradients of Flame.

In his first paper, Professor Lewes says that the Le Chatelier thermo-couple "gives a means of measuring the temperature of flames with ease and comparative accuracy." In a paper which was published in the "Philosophical Magazine," 1894, I adverted at length to the vagueness of the term temperature as applied to flames, and to the impossibility of obtaining any accurate measurement of the temperature of the exceedingly thin sheets of glowing gases (or solid particles) of which flames are composed. Though Professor Lewes, in his last paper,‡ seems to accept and to utilize these views, and in some measure to strengthen them, he still adduces measurements of temperature as the chief basis for his theory. I have therefore made a number of experiments on the subject, with results described in the following paragraph.

The instrument which I have employed for the measurement of flame temperatures is the platinum and platinum-rhodium thermo-couple, which has also been used by Professor Lewes in his experiments on flame. This instrument has the advantage that it can be made of thin wires, which can be so bent that a considerable length of wire on each side of the junction can be placed in the sheath of flame in which the measurement is being made; and thus the drain of heat from the junction by conduction is considerably reduced. The junction was made by singly linking the wires, and then welding them. Since the couple will obviously register the lowest temperature on the surface of contact of the two metals, it is desirable to keep that surface as small as possible; and hence the junction made as above was preferred to a twist of the two wires.

The wires of the thermo-couple had a diameter of 0·5 mm., and were connected by copper wires (the junctions being immersed in water) to a reflecting galvanometer; the total resistance being about 4 ohms. Calibration was effected by means of boiling sulphur (448°) and melting salt (775°). I adopted the statement made by Le Chatelier that the curve connecting E.M.F. and temperature is between these limits a straight line, and assumed that this might be produced even to the temperatures measured. The resistance of the circuit was not high enough to be unaffected by changes of temperature in the region of the junction; but as both the increase of resistance and the increase of E.M.F. are proportional to the temperature, the curve compounded of these two changes should still be a straight line, the slope of which was determined in the calibration. Incidentally, in the use of the couple, the assumptions made were sufficiently justified by the melting point of the platinum wire being determined as 1836° by fusion in a hydrogen flame. (The number given by Violle is 1775°.)

Non-Luminous Hydrocarbon Flames.—It will be convenient in the first place to record the observations made in a bunsen flame, using coal gas. When the air supply to such a flame is

* See "Journal," Vol. LIX., p. 68.

† *Ibid.*, Vol. LIX., p. 795. ‡ *Ibid.*, Vol. LXV., p. 796.

plentiful, a very distinct differentiation into two cones is noticeable. The flame is thus comparatively simple; but it serves admirably to exhibit the precautions that have to be observed in making measurements which shall indicate, even comparatively, the average temperature of the region in which the junction is immersed, and the caution necessary in drawing conclusions from such measurements.

Stretching the two wires of the thermo-couple straight, and immersing the couple in the region of the flame where a measurement was desired, an approximately uniform temperature (1517° to 1542°*) was recorded at all points laterally from the inner cone to the outer cone.

But it is obvious that when the couple is used in the manner described, no valid measurements are possible. Fig. 1 represents a horizontal section through the lower half of a bunsen

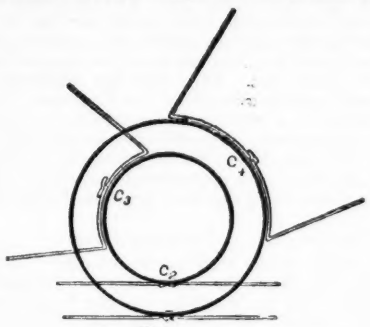


FIG 1.

flame (the concentric circles representing the two cones), showing also the disposition of the thermo-couple. In the position C_1 the junction is heated solely at the point of immersion in the outer cone. In the position C_2 it is heated by immersion in the inner cone. But since the wires pass on each side through the outer cone as well, there is here a second supply of heat which makes the reading relatively too high. This error can be eliminated to a large extent by bending the wires so as to fit the form of the cones (C_3 and C_4 in the figure). A considerable length on each side of the junction is thus immersed, and loss of heat by conduction avoided in both cases. Adopting this arrangement, it was found that the couple registered a temperature of 1611°, or 80° higher in the outer cone at C_4 than in the inner one at C_3. The average temperature of the outer cone is, in fact, considerably higher than that of the inner one. This result is not incompatible with the statement I have previously made to the effect that, when the cones are widely separated, the inner one has the higher temperature. The apparent contradiction is explained by the simple consideration that in a bunsen flame, where the cones are close together, the combustible gases passing from the inner cone have not time to radiate much heat before burning; and consequently to the heat developed by their actual combustion in the outer zone must be added that which they bring with them.

The above experiments, therefore, show two things: First, the fallacious results that may be obtained by not disposing the couple with due regard to the conformation of the zone of flame to be measured; and, secondly, the difficulty of ascertaining the increase of temperature contributed by the chemical changes occurring in any one spot. I have made no attempts to measure the temperatures in the region of no combustion which lies within the inner cone. Such measurements, even if made by thrusting the couple upwards through the burner-tube, would be useless as a means of determining the temperature of the gases, as the stationary couple would obviously be heated to a much higher temperature than the stream of gases, by the heat radiated from the walls of flame which surrounded it. Besides this, there is always the likelihood of slow combustion being induced at the surface of the platinum.

Luminous Coal-Gas Flames.—The flame experimented upon was that given by a No. 4 Bray's union-jet at a gas pressure of about 2½ inches of water. The flame had the form given in the diagram, fig. 2. To obtain any useful measurements in this

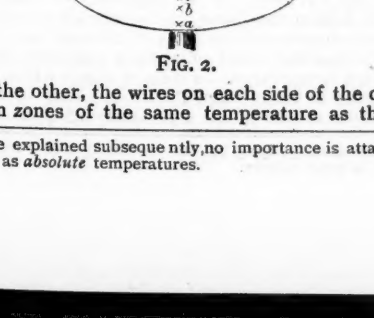
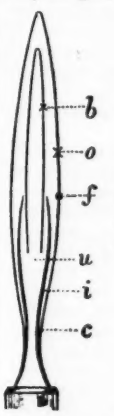


FIG. 2.

case, as in the other, the wires on each side of the couple must be placed in zones of the same temperature as the junction. This may be done approximately by laying the junction and the adjacent wires in a horizontal straight line, and introducing it along the flat face of the flame, so that it may be placed with a considerable length of the wires immersed symmetrically in any one sheath, and passing through parts of the flame in like condition. When the couple arranged in this way was brought up to the flame and passed through it, the readings showed that the flame was invested by a non-luminous sheet of active combustion, in which the temperature was a maximum. At the position *f*, for example (fig. 2), a maximum temperature of 1613° was registered, about 3 mm. outside the luminous sheet. Proceeding inwards, the temperature fell to 1463° at the luminous sheet, and within the sheet (that is, between the two luminous walls) to 1100°, the fall afterwards continuing to about 700° as the soot deposit on the couple grew in thickness. The sheath of high temperature invests the whole flame; but, as we should expect, it varies somewhat in apparent thickness. At the position *a* (quite close to the burner), a temperature of 1478° was recorded on the sheath, and 196° within; at *b*, 1564° and 382°; at *c*, 1560° and 641°; at *d*, 1547° and 947°; at *e*, 1576° and 1110°; and at *g*, where the sheets from either side coalesced, 1613°.

The measurements for the inner parts of the flame given above have only a negative significance. It is obvious that they cannot be true temperatures, inasmuch as the wires have always to pass through the hot outer sheath of flame, and, moreover, the couple would attain by radiation from the outer walls a higher temperature than the rapid stream of gas in which it was immersed. The readings are not even comparable, as the flame varies in breadth and thickness from point to point in a vertical plane. All that can be said is that the readings give no evidence of any sudden thermal change occurring in the space enclosed by the mantle, and that they are in nowise opposed to the view that the stream of gas surrounded by the mantle is steadily heated as it ascends. The recorded temperatures of the mantle are less open to objection, but are still far from being accurate. As just given, they show a slight increase as the flame is ascended. But such an effect might result not from a real difference of temperature but from a difference in the thickness of the sheath. This is, in fact, the case. It was found that a platinum wire of 0·1 mm. diameter could easily be melted in the mantle at the points *a*, *b*, and *c*. It could be melted at *f* only at a distance of 3 mm. outwards from the luminous sheet; and at *e*, it did not fuse in any position.

These results give a temperature slope opposite to that indicated by the thermo-couple. The explanation is, however, very simple, and will be readily seen on reference to fig. 3. At



i, inner blue layer
o, outer lilac layer
} forming the non-luminous sheath.
u, unburnt gas.
b, luminous sheet.

FIG. 3.—DIAGRAMMATIC VERTICAL SECTION OF COAL-GAS FLAME FROM UNION JET.
(Compare FIG. 2.)

the position *c*, the platinum wire is at a point corresponding to the lower part of the bunsen flame where the cones are close together. At *f*, it is on what corresponds to the outer cone at a point much higher in a bunsen flame. A very small shift inwards will, in the first case, put the wire into the region of unburnt gas, and in the second case bring it into a space filled with the products of partial combustion, which, though very hot, will burn at *f*, producing a much higher temperature, as already shown. At the tip of the flame, the constant movements render it impossible to discover a sharp surface of high temperature and to keep the thin wire in it.

In the thermo-couple, we have an instrument which is gross compared with the fine platinum wire. At *c*, it is not thoroughly immersed, owing to the thinness of the sheath; while at *f* and at the tip of the flame, it is wholly immersed in the heated gases from the lower parts of the flame. Hence it registers a higher temperature in the last two cases.

Similar results were obtained with other flames; showing in each case the existence of an external sheath of maximum temperature. It is, perhaps, worth noting that, when hydrogen is burnt from a flat-flame burner, it is possible to melt in it a platinum wire which is quite unaffected in a flame of hydrogen produced at low pressure on the end of a tube of circular section. The pressure at which the gas issues in the first case ensures a rapid admixture with air and consequent formation of a sheath

* As will be explained subsequently, no importance is attached to these temperatures as *absolute* temperatures.

of flame, which is sharply defined and of appreciable thickness. In the second case, the sheath is much more vague.

The chief conclusions which I desire to establish from the experiments described in this part of the paper are as follows:—

1.—There are two chief temperature gradients in a luminous coal-gas flame—one on a vertical axis in the region of unburnt gases, which is in all probability a steady decline from the top to the bottom; the second on a horizontal axis, showing as we proceed from the centre of the unburnt gas a steep ascent to the point of contact with the luminous sheath, then a still steeper ascent to the point of contact with the mantle where the highest point is abruptly attained.

2.—The temperature of the mantle of a coal-gas flame is above the melting-point of platinum, and cannot therefore be determined by a thermo-couple in which this metal is one element.

3.—The measurement of the average temperature of a flame is impracticable; and statements involving the expression can have no scientific meaning.

An inspection of the foregoing results shows as forcibly as could be wished how vague and misleading it is to speak of the temperature of any part of a flame without recording precisely how the measurement has been made. They show, also, that the sudden temperature changes in a flame are found, not in a vertical, but in a horizontal plane; and consequently Professor Lewes's measurements, which relate almost exclusively to points at different heights in the flame, do not afford a satisfactory basis either for mapping the flame into zones, or for any hypothesis as to the cause of luminosity. But the results obtained by a careful use of the thermo-couple go much farther than this. They show that the part of a flame which Professor Lewes describes as "the extreme outer zone, in which the cooling and diluting influence of the entering air renders a thin layer non-luminous and finally extinguishes it," is in reality the very hottest part of a flame; and, further, they do not show a sudden increase of temperature at any point in the vertical plane such as might be expected to arise when a stream of acetylene passing upwards reached the point at which the temperature was sufficient to effect its resolution into carbon and hydrogen with the disengagement of an enormous quantity of heat. The measurements, in fact, are not favourable to the acetylene theory, but the reverse.

On the other hand, the results obtained are entirely in harmony with the views I have previously expressed.* I endeavoured to demonstrate that the bright blue calyx and the lilac mantle of a luminous hydrocarbon flame are essentially of the same character as the two cones of a bunsen flame.† The temperature measurements support this view, and show that this outer sheath is really a region where the combustible gas is mixed with air sufficiently to produce a high temperature non-luminous combustion. The luminous flame must therefore be regarded as invested by a sheath of gas in active "non-luminous" combustion; and the stream of gas within this sheath is naturally the more heated the higher it ascends.

Another point to which I desire to draw attention is, that in a luminous flame it is incorrect to indicate the luminosity as commencing suddenly at a certain height. A moment's inspection of a candle-flame will show that the luminosity begins even below the top of the wick, and increases steadily to a maximum intensity as we proceed upwards, after which it again fades. It is also incorrect to regard the inner (non-luminous) zone as ending a short distance above the wick or burner where, as a matter of fact, to the eye it appears to end. If the image of the sun be focussed on a luminous flame where the light is brightest and where the luminosity seems to extend right through the core of gases, it will be seen, by the double image produced, that there, as elsewhere, the glowing particles constitute an extremely thin sheet, and that, so far as luminosity is concerned, the flame is hollow from bottom to top. The luminosity, in fact, is developed in a candle-flame, except for a negligible distance at the base, over the whole of the flame, and the luminous portion is a sheath of carbon particles lying within the non-luminous investing sheath, and taking a glow which accords strictly with the view as to the genesis of a flame that I have elsewhere laid down.

If any further evidence were required as to the uncertainty attaching to temperature measurements in flames, it might be found in Professor Lewes's own papers. Thus, for a coal-gas flame we have in two separate papers the following two sets of measurements:—

	"Proc. Roy. Soc.," 1895.		"Trans. Chem. Soc.," 1892.
Non-luminous zone	1023°	..	1014°
Commencement of luminosity zone	1658	..	1267
Near top of luminous zone . .	2116	..	1368

It is true that the flames were not of the same size, and therefore the readings might be different; yet we should reasonably expect them to show something like parallelism. It may also be noted that, although Professor Lewes thinks that his figures may be from 100° to 200° too low, one of the temperatures recorded is 100° higher than Deville's, and 330° higher than Violle's, melting-point of platinum—a metal which is one element in the thermo-couple itself.

The Occurrence of Acetylene in Flames.

The origin of the acetylene theory appears to lie in the observation made by Professor Lewes, that this gas is found among the mixture of gases aspirated from a luminous gas-flame. This is quite in accordance with my own previously recorded experience; and it is, indeed, quite in accordance with general principles that, in a region in which hydrocarbons are being subjected to a high temperature, there should be a tendency for the formation of the highly endothermic acetylene. But to say that over 80 per cent. of the unsaturated hydrocarbons present when luminosity commences is acetylene, is likely to give a very false impression as to the importance to be attached to the presence of this gas. The statement is in accord with Professor Lewes's published analysis; but it should be borne in mind that the total amount of unsaturated hydrocarbons is only 1·98 per cent., and that the absolute amount of acetylene is therefore 1·41 per cent. Thus the gas which the flame has elaborated, and which, according to Professor Lewes, is its luminous essence, is a mixture of about 1·5 parts of acetylene and 0·5 part of other unsaturated hydrocarbons with 98 parts of other gases, more than four-fifths of which are actually incombustible. I am at a loss to understand how such a mixture can be supposed to have the properties attributed to it by Professor Lewes.

The Comparison of Different Flames.

Professor Lewes states that the luminosity of two flames of given size, burning from the same jet, should—apart from the acetylene theory—be governed by (*a*) the temperature of the flames, (*b*) the number of carbon particles in a given area.* Subsequently, he lays much stress on the statement that, while ethylene and acetylene contain an equal number of carbon atoms in the molecule, and the flame of the former is hotter than that of the latter, yet the acetylene flame is much more luminous.

Such an argument would, no doubt, have weight if we might regard the two flames as chemically similar. But this is far from being the case. If we are to decide *a priori* what will be the relative number of carbon particles in the flames of two hydrocarbons, we have not only to consider the formulæ of the gases, but likewise their diffusibility and inflammability, and the steps in their combustion which give the particular conformation to their flames. The conditions, indeed, are so complex as to invalidate all theoretical predictions as to the total number of carbon particles. How it can be supposed that anyone will regard two flames as fairly comparable when burning from the same jet, is difficult to understand, seeing that it is perfectly well known, and has been much insisted on by Professor Lewes himself, that different burners are required to develop the full illuminating value of each particular hydrocarbon. In the face of this fact, it is hardly credible that anyone would grant the assumption, so lightly made, as to the relation between the total number of carbon particles in a flame and the formula of the hydrocarbon.

Professor Lewes also speaks of the temperature of a flame as if it were a simple property capable of expression in a simple way, ignoring the fact that the temperature within a flame varies by hundreds of degrees at intervals of a few millimetres; and that the distribution of temperature zones in a flame has a special character for each hydrocarbon.

The Flame of Acetylene.

Great stress is laid by Professor Lewes on the evidence deduced by him from observations on the acetylene flame. This flame undoubtedly possesses extraordinary luminosity; and if the measurements of its temperature recorded by Professor Lewes were valid, there might be some reason to seek for a new theory of luminosity. I am, however, unable to accept these measurements as representing the temperature of the flame; and I cannot understand on what system they have been made. According to Professor Lewes, the acetylene flame is characterized as much by its low temperature as by its high luminosity. Yet observations I have made show that, like other hydrocarbon flames, it is surrounded by a non-luminous sheath of maximum temperature; and this sheath is so hot that the platinum limb of a thermo-couple, which had withstood the highest temperatures of the coal-gas flame, melted when introduced into it. This is not difficult to understand, since here we have not only the heat of combustion of carbon and hydrogen to reckon with, but also the large amount of heat of decomposition of the acetylene molecules. This sheet of high temperature surrounds the whole of the acetylene flame; and there is thus no cause for surprise at its high illuminating effect. It is exactly what we should expect from a flame consisting of a sheath of exceedingly high temperature enclosing a gas unusually rich in carbon, and easily split up by heat. If we suppose the acetylene to be decomposed, within the flame, on the surface of contact of the non-luminous sheath and the zone of unburnt gas, there would be a densely crowded sheet of carbon particles heated to an extremely high temperature—a state of things which must result in a high luminous effect; and I am not aware of any grounds for supposing that this is not a perfectly adequate explanation

* See "JOURNAL," Vol. LIX., p. 68.

† An important piece of evidence as to the nature of the blue calyx to which I did not allude in the paper referred to, is afforded by the spectroscope. It is this part of a luminous flame, and this part only, which gives the "carbon" spectrum, and as is well known, the same spectrum is given by the inner cone only of a bunsen flame.

* The word "area," judging by the context, is used here, as elsewhere in the paper, to mean volume.

of the marked illuminating value of the acetylene flame. The introduction of a platinum wire into the external non-luminous sheath of an acetylene flame shows at once that, contrary to Professor Lewes's explicit statement, the temperature of the flame, due to combustion, is perfectly adequate to produce a glow not less bright than that actually shown by the carbon particles.

Thermo-Chemical Considerations.

Professor Lewes maintains from his observation that the flame of acetylene is characterized by low temperature, and that consequently some fresh theory is required to account for the high luminosity of the carbon liberated within it. To obtain such a theory, he has recourse to thermo-chemical considerations which are, I believe, both uncalled for and incorrect.

He first alludes to the highly endothermic character of acetylene, and to the fact that when this gas is decomposed by heat the carbon is luminous at the moment of separation. This decomposition, even when occurring in flames, he regards as taking place "with a rapidity almost akin to detonation;" the heat evolved being confined to the liberated products. It is thus possible to have a highly luminous flame of low "average temperature."

Now, in an acetylene flame we are dealing, according to Professor Lewes, with acetylene in the act of burning, and acetylene in the act of separating into its elements. The latter process, he states, is calculated to produce a temperature of over 6000°; the former gives a calculated temperature above 3000°. It is therefore difficult to see how a flame made up in this way could possess a low average temperature. It surely is not supposed, because acetylene decomposes "with a rapidity almost akin to detonation," that the thermal effect of this operation occurring continuously in the flame is incapable of being detected by the thermo-couple.

It appears to me that the only circumstances where the argument at first sight seems applicable, would be where a flame of a hydrocarbon burning with a low average temperature contained a comparatively sparse supply of acetylene molecules. If these sparsely distributed molecules were supposed to undergo decomposition, and the heat to be localized in the liberated carbon and hydrogen, then there might be a number of *loci* of extremely high temperature which would have little effect on the general average. But such an argument would only hold good for explaining abnormally high luminosity if the source of light were gaseous carbon. If this view is excluded, and the luminosity attributed to carbon particles, then to form these particles the coalescence of the liberated atoms is essential; and before this coalescence could be effected between atoms which are *ex hypothesi* widely separated, they would inevitably have departed far from their original unique condition of temperature by encounters with the foreign molecules among which they are dispersed.

Professor Lewes says "the supporters of the 'solid particle' theory of luminosity agree in concluding that the liberated carbon, existing as it does in a state of molecular division, is heated to incandescence." I am quite unable to understand the meaning of these words. Is the expression "a solid body in a state of molecular division" to be taken as a periphrasis for the word "gas?" If it is, these words sound the keynote of much that follows in the paper; for while throughout be continues to speak of solid particles of carbon as the source of light in hydrocarbon flames, his theoretical speculations are applicable only to atoms.

The Alleged Liberation of Carbon from Cyanogen in Flames.

Among the indirect evidence which Professor Lewes adduces in support of his theory is an observation with respect to the behaviour of cyanogen, which, if correct, would be interesting, and perhaps of importance. He points out that this gas is more highly endothermic than acetylene; and he argues that, if raised to a sufficient temperature, it should be resolved into its elements with a not less striking luminous effect than that seen with acetylene. He then describes an experiment in which a jet of cyanogen is sent up into a hydrogen flame, "with the result that the flame at once became luminous; and on surrounding the hydrogen flame with an atmosphere of oxygen to increase the temperature, the luminosity was considerably increased."

I repeated this experiment precisely according to Professor Lewes's statement. A yellow luminosity was at once noticed; and it is true that it is not unlike what might arise from a sparse supply of carbon particles. But on placing a cold piece of porcelain in the flame, no trace of a deposit of carbon was obtainable. This fact, together with the hue of the flame, suggested the idea that the luminosity might be due to the formation of ammonia by the action of the hydrogen on the cyanogen. This turned out to be the case. Substituting a jet of ammonia for one of cyanogen in the experiment, a similar luminosity was obtained; and on arranging a double apparatus—one being cyanogen with hydrogen, and the other ammonia with hydrogen—and observing the spectra of the two flames simultaneously in the field of view of a spectroscope, I found a complete coincidence of the lines and bands. The substitution of an atmosphere of oxygen for one of air certainly caused a brighter appearance; but this was mainly due to the glow of the platinum orifice, and to the introduction of more sodium into the flame. As a matter of fact, the oxygen suppresses the formation of ammonia; and the cyanogen burns with a flame giving its characteristic spectrum, though slightly brighter than in air.

The arguments deduced by Professor Lewes from the behaviour of cyanogen, therefore, are invalid; and instead of forming a support for the acetylene theory, the evidence deduced from the behaviour of this gas is, if anything, antagonistic to the theory.

I subjoin a statement of the chief conclusions arrived at in this paper, in addition to those already enumerated:—

1.—The description of the structure of a flame adopted by Professor Lewes is not in harmony with the facts.

2.—There is no evidence of more than a very small percentage of acetylene at any point within an ordinary luminous flame (the acetylene flame itself alone excepted); and the acetylene that is formed is associated with so large a quantity of other gases that there is no reason for supposing that it is of primary importance in the emission of light.

3.—There is no evidence of any local condition of temperature within the flame such as would point to the decomposition of acetylene with the evolution of much heat.

4.—The mapping of flames adopted by Professor Lewes is based on temperature measurements which are erroneous, and of no valid applicability for the purpose in view.

5.—The conclusion in favour of the acetylene theory based on the comparative luminosity of the ethylene and acetylene flames is due to neglect of the consideration that in the latter there are higher temperatures and greater relative amount of carbon.

6.—The indirect evidence deduced from the behaviour of cyanogen arises from the yellow ammonia flame having been mistaken for one containing solid carbon.

7.—The theoretical arguments based on thermo-chemical considerations are invalid.

8.—The phenomena of luminous hydrocarbon flames can be adequately explained without the acetylene theory.

If the criticism which I have offered is just, then the acetylene theory of luminosity will share the fate of the "dense hydrocarbon" theory. We know that all hydrocarbons in contact with hot surfaces deposit carbon; and this is what occurs in their flames. What else is produced as the carbon is deposited is, I think, after all a problem of comparatively little interest. I have previously indicated one way in which it might be attacked; but I have found the experimental difficulties practically insurmountable. Our means of analysis are quite insufficient to deal either qualitatively or quantitatively with gases containing a very small percentage of an unknown number of hydrocarbons, many, it may be, belonging to the same homologous series. The solution of this problem must, I fear, be delayed for a very long time.

In connection with this paper, I have received most valuable assistance from Mr. G. R. Thompson, B.Sc., to whom I here desire to acknowledge my indebtedness.

NOTES ON WEIGHBRIDGES.

One of the papers presented to the Institution of Civil Engineers last session was on the subject of weighbridges; the author being Mr. Oscar J. Kirby, Assoc.M.Inst.C.E., the Engineer and Manager of the Batley Corporation Water-Works. We have received a copy of the paper; and as most of our readers are more or less affected by the use of weighbridges, we give an abstract of it.

The author points out, in the first place, that a weighbridge may be so designed as to have either a vibrating or an accelerating motion; and though greater accuracy can be obtained with the former than with the latter, the machine is much slower in action. The oil applied to clean the bright parts of a weighbridge often produces adhesion between the steelyard and the lower stop. This difficulty is overcome by keeping the under edge of the steelyard free from grease; and, as a precaution, a little chalk should be frequently rubbed on the face of the lower stop. Equilibrium must always be indicated by the steelyard returning to its proper position of rest when brought to the lower stop and gently released, and by its not rising when the traversing or sliding poise is placed upon the first graduation above zero. The balancing-screw, or balance-ball, as the case may be, is often the cause of much difficulty. The most troublesome form is the rotating balance-ball, especially if it turns freely on the spindle, as its position is easily altered by the impact of the steelyard upon the stops, causing the machine, after a few weighings, to be out of balance to the extent of several pounds. A small set-screw with a crutch head should be fitted to a balance-ball of this type, so that it may be clamped in any desired position. In all new machines, the balance-weight should be moved in a forward or backward direction by means of a mill-headed screw passing through a fixed diaphragm, or by some other device which will prevent it moving of itself. A weighbridge should be periodically tested by placing forty standard half-hundredweights first upon the centre of the table and then upon each corner separately. A machine may indicate true weight when the load is put upon the centre of the table; but when placed at the corners, different results may be obtained. This irregularity is produced by the resilient motion given to the table

by the horses drawing loads on to it, and by backward thrust of the revolving wheels of vehicles, or by lateral or oblique thrusts caused by the horses not taking a straight course when leaving the table; and in the case of railway-truck weighing-machines, by the backward thrust of the wheels and the lateral thrust of their flanges. These discrepancies may be corrected by re-gauging the knife-edges to give each lever its true length. Care must be taken to keep the knife-edges in the same horizontal plane by levelling with parallel straight-edges and a spirit-level. If the standard weights produce the same result on the steelyard, whether placed upon the centre or the four corners of the table, the machine should be tested to its maximum capacity. If the error of a weighbridge does not exceed 1-2000th of the load weighed on a machine of 20 tons capacity, 1-5000th of the load on one of 40 tons capacity, or 1-6000th of the load on one of 100 tons capacity, the requirements of almost any local authority are complied with, provided the machine has been authorized and stamped.

Under favourable circumstances, a weighbridge should maintain its sensitiveness and good working condition for a much longer period than is generally the case. But the dampness of the pit, and the ammonia gas which finds its way into it, soon combine to produce corrosion of the bearings and knife-edges, with the consequent blunting of the latter. To keep the pit dry, a 3-inch or 4-inch drain-pipe is frequently carried from the pit to the nearest drain or sewer—a stench-trap being in some instances fixed in the drain-pipe. Even where a trap is used, its value is to a considerable extent destroyed by the lengths of the periods which may elapse between the changes of the water in it; in fact, it may often happen that, for want of water, the trap is not sealed. The weigh-house, or office, then becomes a dangerous place, as sewer gas will readily find its way into it from the pit along the channel of the main power-lever—the heat of the office aiding its ingress. The ammonia gas which comes from the sewer acts injuriously upon all the metal of the machine; but more particularly upon the bearings and knife-edges. It often occurs that the steelyard is arranged to work inside an office where several clerks are engaged; and the defective drainage arrangements of weighbridge pits may be in a great measure accountable for the high percentage of zymotic diseases among clerks and storekeepers. In the borough of Batley, three clerks in one office were in 1892 striken down with typhoid fever in five months. The drain from the weighbridge pit was suspected by the author, and disconnected from the sewer. No case of zymotic disease has since occurred; and the objectionable condition of the air in the office when first entered in the morning has not been detected. These drains do not often come under the notice of sanitary officers, or the dangers from this cause which obtain generally would not exist. When the drain-pipe from a pit has to be connected with a sewer, it should be made to discharge itself into the inlet end of a disconnecting trap through which other drainage passes, so as to ensure the trap being always sealed.

The table of a weighbridge is sometimes placed at a higher level than the surrounding ground, to prevent surface drainage entering the pit, and so obviate the necessity of draining it; but unless the table is under an arch, or is otherwise protected from the weather, it will collect sufficient water to produce fermentation or putrefaction in the pit, which will in its turn make the weigh-house a dangerous place. In the event of the water at any time being deep enough to reach the levers, the weighings will be affected by between ¼ lb. and ¾ ton, according to the depth of the water, as the levers, when submerged, are partially supported by it—the resistance of the table being thus reduced. A pit should be properly drained, and the air within it kept dry by lime, which should be changed at intervals. The lime must be so placed as to prevent its contact with water. Or if the channel of the main power-lever be carried forward under the floor of the office to the fireplace, and a grating about 18 in. by 12 in. let into the floor over the channel, the air will be drawn from the pit by the fire unless the office door or window is open. As a fire carries about 150 cubic feet of air per minute up the chimney, it is obvious that it can be used for changing the air in a weighbridge pit. Many other methods of keeping the pit dry will suggest themselves, according to circumstances connected with the position of the weighbridge.

Petroleum in the Congo.—It has always been supposed that petroleum exists in the Congo; and, in fact, throughout the whole of the coast region there are small wells, yielding blackish or brownish viscous matter, with which the natives coat their canoes and the posts of their huts. Travellers who have studied the deposits in the province of Angola, have concluded that this substance is bitumen, several wells of which have been pointed out in the lower Ogooue and the Ngounie. There is a spring on the borders of Lake Isanla, six hours from Ncogo, on the left bank of the Ogooue, above Lambarene; and an intermittent spring occurs in the region of Fernan Vaz. The calorific value of the two samples obtained from this region are, according to tests made at the Paris School of Mines, very similar; and an American contemporary says it is probable that a good mineral oil may be obtained by distilling these hydrocarbons, taken from a sufficient depth to avoid the oxidizing action of the atmosphere. Boring will, however, alone reveal the value and importance of the product.

REGISTER OF PATENTS.

Prepayment Gas-Meters.—Alexander, W., and Milne, J., of Edinburgh. No. 24,032; Dec. 11, 1894.

The illustrations show two modifications of this arrangement of prepayment gas-meter.

Fig. 1 is a front elevation of the upper part of the meter partly broken away. Fig. 2 is an end view. Fig. 3 is a plan of the meter top, with the cover removed. Fig. 4 is a sectional plan of the coin-receiver and coin-actuated mechanism to an enlarged scale.

Fig. 1.

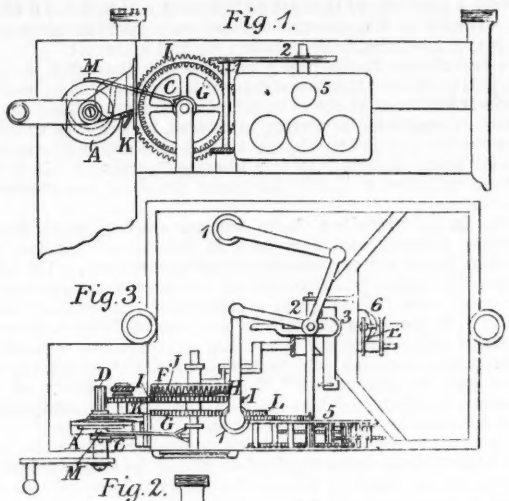


Fig. 3.

Fig. 2.

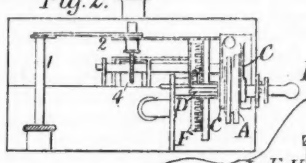
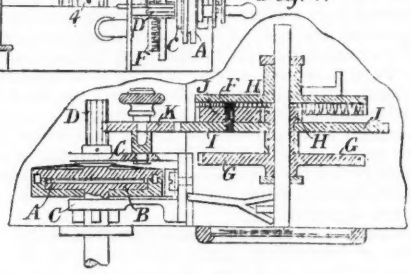


Fig. 4.



The meter is fitted with the usual spindles 1, tangent 2, worm 3, worm-wheel 4, and train of wheels 5, for indicating the amount of gas passing through the meter. The prepayment mechanism is placed in the upper part of the case, beside the ordinary train of wheels 5 registering the consumption of gas. The coin-receiver A, which actuates the mechanism to open the gas-valve 6, consists of two discs, connected together at the edges a short distance apart in such a manner as to leave two openings at opposite sides sufficiently wide to allow a penny (or other prearranged coin) to drop through. The disc placed next to the front of the meter-case may have a collar or hollow trunnion on it at its centre. But, as shown in fig. 4, this can be dispensed with, and the disc be held in position by a stud-spindle from the centre of the disc B. The other disc has a stud-spindle, and both are carried by standards or a forked bracket C, on the end of which is a small pinion D to actuate the valve-opening mechanism, to be described. A segmental spring or curved plate is secured between the bracket C and the face of the disc, to act as a brake.

The disc B is secured to the end of the stud-spindle, passing out through an eye-bearing on the bracket C to the outside of the meter-case, where it is furnished with a handle for turning. It is also provided with stops, to regulate the amount of rotation. The disc B has a crescent shaped rim formed on its inner face around part of its circumference, so arranged that when a coin is dropped into the receiver A, it will not pass completely in, but a sufficient portion projects to cause it to engage with the duplex disc already described; so that when the inner disc B is turned a half turn, the duplex disc is carried along with it, and by means of the pinion D actuates the mechanism to open the gas-valve 6. This valve, which may be of the ordinary plunger type, may be opened and closed by a lever E fulcrumed on a standard, as shown in fig. 7; or, as shown in fig. 3, it is connected to the end of an oscillating spindle having an arm at right angles to it, on the end of which is fitted a fork. One limb of this is moved to open the valve by oscillating the spindle and lever E, and the other limb to close the valve by means of a pin (projecting from the side of a crown-wheel F actuated by the coin-receiving appliance when turned on the insertion of a coin), which comes into contact with the lower limb of the fork shown in fig. 3, to open the valve. By coming into contact with the upper limb of the fork (when the wheel F has been revolved in the opposite direction by the consumption of the gas), it closes the valve.

The crown-wheel F is secured to a spindle carried in eye-bearings in the tops of the standards; and the outer end of the spindle may be furnished with a pointer to indicate the amount of gas paid for, or the number of coins inserted, on a dial behind a glazed opening in the case. Or, conversely, it may be furnished with a disc F^1, and the pointer be stationary, as shown in figs. 6 and 8. A loose toothed

wheel G is carried on the spindle shown, and on the other end a smaller toothed wheel H is secured; while another and larger loose toothed wheel I is carried between the wheels G and H secured to it.

A small loose pinion J is mounted on the face of the larger toothed wheel I, so as to engage with the teeth of the smaller wheel H, and also with the teeth of the crown-wheel F secured to the spindle carrying them all. The larger loose wheel I is revolved by a pinion D on the stud-spindle of the coin-receiver A, either direct or by means of an intermediate wheel K; while the wheel G gears with the ordinary gas indicating mechanism 5, by means of a toothed wheel L.

When a coin is inserted in the receiver A, and it is turned, the pinion D turns the larger loose wheel I by the toothed wheel K, which, by means of the loose pinion J attached thereto, turns the crown-wheel F. Thereupon the projecting pin on it comes into contact with the lower limb of the fork connected with the gas-valve lever E, so as to depress it and open the valve 6. When gas is being consumed, the train of wheels 5 turns the loose wheels G and H; and the smaller wheel H, by gearing with the pinion J on the large loose wheel I, turns the crown-wheel F in the opposite direction, until all the gas paid for is consumed, when the projecting pin on the crown-wheel F comes into contact with the upper limb of the valve-lever fork, and closes the valve.

In order that the mechanism may be arranged to suit variations in the amount of gas to be delivered for each coin inserted, the small pinion D may be so secured to the trunnion of the coin-receiver as to be removed and replaced by a larger or smaller one; and in this case the intermediate wheel K would be mounted on the end of an oscillating lever fulcrumed at any convenient part of the case, as shown in figs. 8 and 9, which would allow of a change of position to suit the different sizes of the pinion. Otherwise pinions of different sizes may be used, or the intermediate wheel K may be interchangeable; and, as shown in fig. 4, it may be mounted on a short spindle carried in a slot, so as to be capable of being raised when a larger intermediate wheel is used.

Fig. 6.

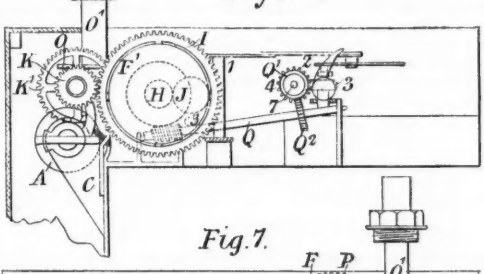


Fig. 7.

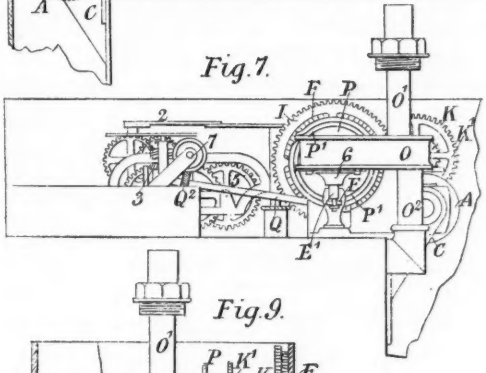


Fig. 9.

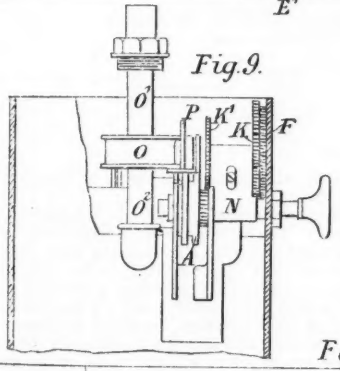
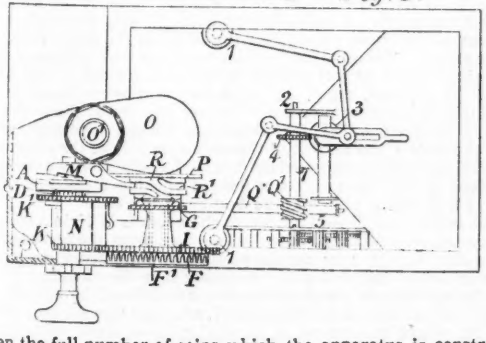


Fig. 8.



When the full number of coins which the apparatus is constructed to receive at one time have been inserted, a plate M mounted on a lever is made to pass over the opening of the coin-receiver A, and under the coin-slot (not shown in the engravings) in the top of the meter-case, and so prevent the introduction of more coins. This lever being oscillated, covers and uncovers the opening by means of a round pin on the spindle acting on the forked end of a lever, one limb of which is angled downwards, and the other upwards. According to the direction in which the spindle is being turned, the pin acts on the lower limb to oscillate the lever to cover the opening; and on the reverse revolution of the spindle, when some gas has been consumed, it acts on the higher limb to uncover the opening—the first named movement bringing the limb into the path of the pin.

In figs. 6 to 9, the construction of the coin-receiver A is the same as in that already described; the spindle passing through an eye in the lower part of the oscillating frame N, and supporting it in position. The train of coin-operated wheels D, K, K^1, H, I, J, and F (for opening the gas-valve) are also practically the same as in the previous modification. The gas-valve 6, which is here situated within a partitioned gas-chamber O—that receives the gas from the inlet-pipe O^1, and passes it into the meter by the pipe O^2—is opened, and kept open (until all the gas paid for is consumed) by the end of the valve-lever E, which reciprocates its spindle E^1 and engages with the cam-groove P^1 in the face of the revolving disc P. One end of this cam-groove P^1 acts as a stop when as much gas has been paid for as the mechanism is constructed to deliver; while the other end of the groove opening to the edge of the disc causes the end of the gas-valve lever to be depressed when all the gas is consumed. The disc P is revolved when the gas is being consumed, by the wheel G operated from the ordinary recording mechanism. In this modification, instead of the wheel L connecting the wheel G with the recording mechanism, a spindle Q is operated by a worm Q^1 on the spindle 7, turning the spindle by the worm-wheel Q^2, and which turns the wheel G by another worm Q^3. The plate M covers and uncovers the opening to the coin-receiver A by a lever oscillated by the cam-groove R^1 on the circumferential surface of the boss R, which (along with the disc P) is secured on the spindle of the wheel F. The interchangeable wheel K is secured to the end of the spindle, carrying the wheel K^1, through which wheel it receives its motion from the pinion D, so that it can be easily removed and replaced with one having a different number of teeth when it is necessary to adjust the mechanism so as to suit variations in the price of gas. The spindle of the wheels K and K^1 are carried in an eye at the upper part of the oscillating frame N, which is adjustable in position by a screw on the meter case, so as to hold the wheel K in working contact with the wheel I.

Generating Oil-Enriched and Illuminating Water Gas.—Thwaite, B. H., of Finsbury Pavement, London. No. 940; Jan. 15, 1895.

This process and plant, having for their object "the production of an oil-enriched and luminous water gas," aim at the following improvements on existing systems: (1) Reduction of the percentage of carbon dioxide in the gas produced. (2) More complete volatilization of the oil. (3) Lessened consumption of the oil gas during the periods of revivification. (4) More perfect safety arrangement of working. (5) Greater power of production with a given size of plant. (6) More convenient method of removing the clinker. (7) Simpler method of effecting the reversals of the gas-valves.

Fig. 1.

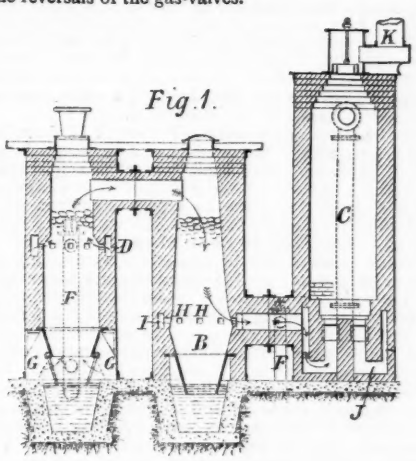
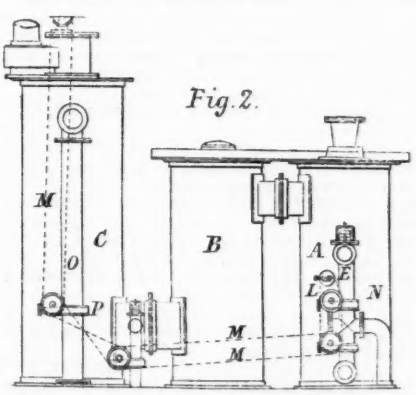


Fig. 2.



In the illustrations, A and B are both fuel-fed vessels; the fuel used being either coal, coke, anthracite, or charcoal. The third vessel C is filled with refractory materials superposed on a solid substratum of walls, so as to obtain equal distribution of the heat to the absorbing bricks. Both vessels A and B are provided with special facilities for the rapid removal of the clinker, and in such a manner as not to interfere with

the progress of gas making. The fuel is fed into the first vessel A by a bell type of hopper, and into the vessel B by the "retort kind of feed" shown. The base of the fuel in both vessels rests in water-baths A, by means of hanging fire-bars. The water-filled bath extends on one side beyond the gas-generator casing, as shown in fig. 3; but by allowing the casing to dip beneath the surface of the water for (say) 8 to 12 inches, the accumulated clinkers can be removed by merely inserting a rake below the casing, without involving the escape of gas, steam, or air. The second vessel B has also a water-bath, which may or may not be connected to that of the first vessel. It has not, however, any suspended fire-bars, but its cone dips into water for a depth of some 8 inches; and thus any tarry matter descending along with the clinker floats on the surface of the water, and can easily be removed. The coke or other fuel is fed into both vessels up to the level of the connecting upper conduit, which is lined internally with refractory materials.

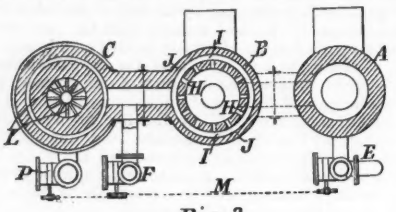


Fig. 3.

At about two-thirds the height of the vessel A, is an annular flue D, which serves for the introduction of a secondary supply of air-blast or steam into the fuel. The secondary air supply is provided through a vertical main E, and is connected to the under grate part of the first generator-vessel A. A third air supply is provided to the refractory lined flue connecting the vessel B to the vessel C by the vertical air-mains E F, provided with dead-weight valves.

Assuming that fuel is charged into the two vessels A and B, and the air-blast introduced into the annular space G, the blast raises the fuel to a high state of incandescence, the air being converted, along with the water vapour evaporated from the water in the bath, into carbon monoxide and hydrogen. The secondary air-blast supply, entering just above or below the upper surface of the fuel in A, provides the air for the combustion of the two gases; the flame which results flowing through the upper conduit connecting A and B. The flame then flows through the fuel in the second generator, raising it to a state of incandescence. In descending through the incandescent fuel, the products of combustion produced in A are re-arranged into carbon monoxide and hydrogen. All the gases escape through the outlet-ports H, and into the annular flue I formed at the base of the second vessel, and are gathered by this flue for introduction into the connecting flue to C, where the introduction of a third supply of air is effected, by which the combustible gases are inflamed. The flame flows into the annular flue J, from the base of which it escapes into an inner vertical annular flue, ascending this flue, and filling the upper checker brick-work part of C. The flame (which passes through all the interstices between the bricks, because combustion is effected under pressure) finally escapes from the top of C through a valve, preferably of inverted mushroom form, into the chimney K.

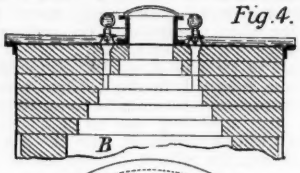
When the fuel in A and B and the brickwork of C are heated up to the required temperature, the second cycle of gas production can be commenced. This involves (as an essential principle) the closing off of the three air supplies, and the introduction of steam and oil into the vessels. The closing of the air supply is effected simultaneously by the wheel-valve L and link-chains M that actuate the air-valves. The rotation of any one of these wheels (controlling the others) can be effected automatically by means of a water-tilting gear having two buckets of unequal size, so that there are alternate periods of reversal of duration—that is to say, when the largest bucket of water of the tilting gear is being filled, the operation will take (say) ten minutes, and when the smaller one is being filled, the operation will take (say) five minutes, or the alternating operations can be effected in terms of equal duration. The chain-link action, besides controlling the air-valves, actuates the steam and oil valves—when the air-valves are closed, the steam and oil valves are opened. The valve N enables steam to enter at the base of A, from which it flows into the incandescent fuel, in ascending through which it is converted into water gas, so that when it reaches the air-ports, part of it can be consumed. The water gas and the small proportion of water vapour resulting from the introduction of the secondary air supply pass into the space above the fuel in B, where the gases are united with vapour and gas generated from oil introduced either into the cross-conduit or into the upper level of fuel in the second vessel.

The oil and gas vapour, along with the water gas, flow downwards through the incandescent fuel in B. Water vapour resulting from secondary combustion is converted into hydrogen and carbon dioxide; and the oil vapour is converted into permanent gas—any liquid hydrocarbon remaining being gasified in descending through the incandescent fuel. The final gases flow into the third vessel, in passing through the incandescent brickwork of which the still unfixed gases are fixed, and the permanent hydrocarbons or enriched water gas escape by the downcomer O in the mains leading to the purifying or gasholder plant, to be stored for use. The downcomer O is provided with a dead-weight safety-valve, and with a reversal valve P. In reversing, this valve is the last to be closed, in order that the whole of the carbon dioxide and other residual gases remaining after revivification may be able to escape through the chimney.

Figs. 4, 5, and 6, show details of the arrangement for injecting oil into the generator vessels A and B; fig. 4 showing a section of the upper portion of the generating vessel B.

The oil is lead to distributing coil-pipes under pressure. At one or more positions in the circle, spring-weighted valves are provided to prevent the oil from escaping, unless a certain pressure (sufficient to overcome the counteracting pressure of the helical spring in maintaining the valve-plugs on their seat) is established. An enlarged section of the valves is shown in fig. 5. The central plug of gun metal or turned steel, makes a tight fit on the gun-metal seat Q. When the pressure of oil is suddenly increased by the action of the pump, the valve-plug is forced from its seat, and allows the oil to escape, falling into the gas-generating vessel B, through the orifices R formed in the refractory lining. The oil falls in a ring-shaped shower on to the upper part of the fuel, and is spread over a considerable area of the fuel.

Fig. 4.



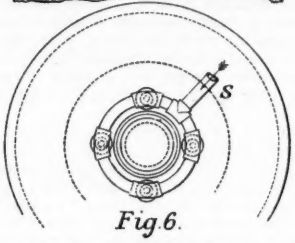


Fig. 6.

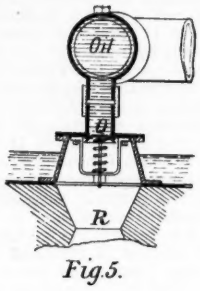


Fig. 5.

Fig. 6 shows a plan of the ring distributing-pipe, with its four outlet-valves. The pipe S supplies the distributing coil for a force-pump. When the enriching process is desired, the feed-pump is put into action, forcing the valves from their seats; but immediately it is desired to stop the enriching action, the pump is stopped, and the pressure on the plugs of the valves being removed, they immediately close, stopping instantly the flow of oil into the generator.

Cracking or Gasifying Oils, Tars, &c.—Horsfall, R. V., of Slaithwaite. No. 2188; Jan. 31, 1895.

This plant, constructed for "distilling, cracking, or gasifying" oils, tars, or any liquid hydrocarbons, consists of an "improved construction of furnaces, arrangement of retorts, and improved connections between said retorts."

Fig. 1.

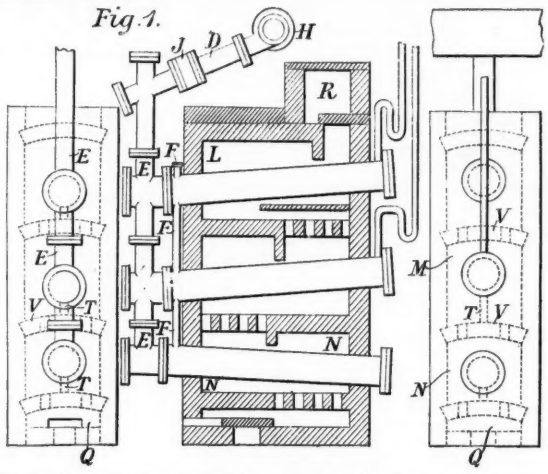


Fig. 1 shows the front elevations of a bench of retorts and a part sectional elevation of same.

The retorts are placed at an angle, in tiers in a furnace (constructed as hereafter described). The retorts are made with short flanged pipes or openings E and a subsidiary pipe F, connected with the lower ends of the upper retorts and the upper end of the bottom retort. The upper end of the pipe L connects with either a main or a condenser (as H), by means of a pipe D, in which a valve J may be fitted. The connections E form an ascension-pipe, by which a direct conduit for the produced gas is obtained, and also direct means for the conveyance of residuals from the upper retorts and the main or the condenser to the bottom retort. A subsidiary pipe (as F) may be employed, so as to form an additional passage for the oil from the upper retorts to the lower retort. The oil is fed into the retorts in the usual manner by the feed-pipes, which project into the raised ends or sides of the upper retorts. If required, one of the pipes may also be employed to convey residuals from the main or the condenser into one of the retorts.

In a modification of the invention, flanged openings are made near the ends of the retorts, at the underside only of the upper retorts; and each opening is connected by means of an elbow with a vertical pipe attached at the lower end to a flanged opening, formed on the upper side of a ⊓ retort, placed at the bottom of the tier.

The retorts are placed in separate chambers L M N, in which baffles are constructed, so as to cause the hot gases from the furnace to enter a chamber (as Q), from thence passing through apertures formed at the rear end of the roof of the chamber into the chamber N. After circulating through the chamber, they are deflated by a baffle placed at the forward end of the chamber N, and pass upward into the chamber M, where the course of circulation is reversed, and a baffle is placed under the rear end of the chamber.

In applying the invention, the hot gases from the furnace are caused to enter a chamber (as Q); and from thence, passing through apertures formed at the rear end of the roof of the chamber, they reach the chamber N. After circulating through the chamber, they are deflected

by the baffle placed at the forward end of the chamber, and pass upward through apertures into the chamber M, where the course of circulation is reversed. A baffle is constructed near to the rear end of the chamber M, by which the hot gases are deflected and pass up into a flue, by which they are conveyed to the front portion of the chamber L, through which they circulate, passing out finally into the flue R of the chimney. By these means, each of the retorts is subjected to different degrees of heat; the greatest amount being caused to circulate, and to be uniformly distributed around the bottom retort. The upper retorts are subjected to a decreasing temperature as the hot gases pass through the several chambers in their passage towards the flue R; and the whole of the products of combustion in the furnaces are thereby utilized.

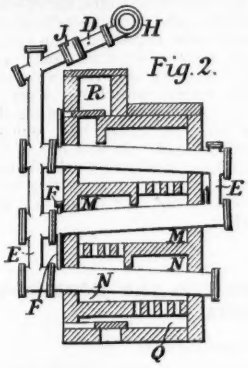


Fig. 2.

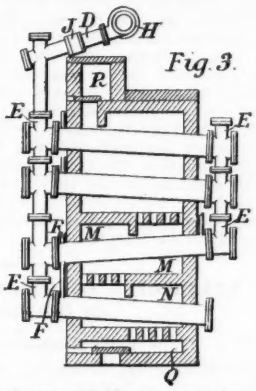


Fig. 3.

In fig. 2, a bench of our retorts is shown with the two upper retorts placed side by side in the top chamber, and inclined from front to back. The oil is fed in at the front in the two top retorts; and in the retort contained in the middle chamber, the oil or residuals are fed in at the back.

In fig. 3, a bench of four retorts is shown; the two upper retorts being placed one above the other, and enclosed either in one chamber or in separate chambers, and inclined from front to back. The oil or residuals are here fed into the two upper retorts at the front, and the intermediate retort is fed at the back.

High and Low Pressure Gas-Generators.—Pennink, J. M. K., of Haarlem, Holland. No. 2594; Feb. 6, 1895.

This invention relates to apparatus into which a compressed explosive mixture (say, of combustible gas and air) is continually fed. The mixture is thereupon successively exploded in certain chambers of revolving drums; and the explosion products are discharged, partly into a first and partly into a second line of piping. The products of the explosion being nearly continually fed into the two pipe-systems, a stream of high-pressure gas is obtained by the first pipe-line, and a stream of low-pressure gas by the second. These two kinds of gas are separately conducted (in a similar manner as steam or compressed air) to engines, injectors, and so on, for the purpose of driving same.

APPLICATIONS FOR LETTERS PATENT.

14.—Booth, H. S., "Gas or oil motors." Jan. 1.

56.—Carter, W., and Prall, J. H., "Outdoor lamps and lanterns." Jan. 1.

75.—Warn, W. W. R., and King, L. F., "Calcium carbide gas generators." Jan. 1.

148.—Potter, W. G., "Incandescent mantles for gas or oil lamps." Jan. 3.

155.—Stead, C. M., and Brooke, J. E., "Enriching and burning lighting gas." Jan. 3.

156.—Procter, H. T., and Gill, R. E., "Regulating the supply of gas or electric light to railway coach compartments." Jan. 3.

180.—Bollmann, L., and Kohnberger, S., "Turbines driven by steam or gas." Jan. 3.

189.—Chaux, P. C., "Supporting the mantles of incandescence gas-burners." Jan. 3.

252.—Harris, H. J. and W. A., "Application of an automatic air-suction valve or valves to water-service systems, domestic or otherwise, for the purpose of thoroughly draining the water from such systems during frost." Jan. 4.

266.—Loftus, Sir A. J., and Rowlands, E., "Street lighting and other lamps." Jan. 4.

282.—Courtenay, R. H., "Lamps for the combustion of specia chemical compounds, with means for condensing the burnt products of combustion." Jan. 4.

The West Riding County Council and Local Bills.—The West Riding County Council resolved last Wednesday that, unless clauses in protection of the interests of the Council and of the inhabitants of the Riding, to the satisfaction of the Law and Parliamentary Committee, be inserted in the Sheffield Corporation Water Bill, the Huddersfield Corporation Water Bill, and the Settle Gas Company's Order, petitions should be presented praying to be heard against them.

Supposed Lead-Poisoning by Water at Mosbro'.—Great alarm has been engendered at Mosbro' and the adjacent villages by an epidemic which has recently broken out, and which is reasonably supposed to arise from lead-poisoning through the medium of the water supply. The Medical Officer for the affected district (Dr. Mackintosh, of Chesterfield) does not appear to have the least doubt as to lead-poisoning being at the root of the mischief; and he has taken samples of the water for analysis by the Government officials. During the week ending the 4th inst., no less than 50 workmen employed at the Holbrook collieries were affected.

CORRESPONDENCE.

[*We are not responsible for the opinions extressed by correspondents.*]

Explosions of Domestic Boilers.

Sir,—The Secretary of the Deal Water Company, whose letter on the above subject appeared in the "Journal" for the 31st ult., has apparently missed the point of the question—not whether it is desirable that persons should be told how to avoid blowing themselves up with boilers in houses, but whether the water authorities are the proper bodies to be called upon to proffer advice in the matter. His Company apparently had to confer with an authority on boiler explosions—Mr. Lavington E. Fletcher—before launching their suggestions. Nor do these suggestions appear to be an embodiment of lucidity and completeness. They relate to domestic boilers only; yet, without the slightest intimation of a standard for distinction, he at once differentiates low-pressure circulating boilers from high-pressure circulating boilers. He thus hopelessly confuses the reader, and without necessity; for I have before me particulars of safety-valves designed by Mr. Fletcher, which "provide a safeguard that can be depended upon," and which, it is advertised, have during 25 years conferred immunity from such accidents; and these are loaded to 60 and 80 feet head of water. Surely, with such appliances available, it is unnecessary to obtrude these distinctions in a circular relating to boilers in domestic use, unless it be to refute the claims of Mr. Fletcher's safety-valves.

Moreover, the suggestion to *keep up the fire, and not only the boiler but the entire range of pipes hot*, as long as the frost lasts, unaccompanied by any reference to the concurrent maintenance of the inflow of water to the boiler, is one which may possibly be misinterpreted with serious consequences. Indeed, the pursuit of this advice might, if the water supply became exhausted, lead to an explosion as bad as, or worse than, would ensue from freezing of either the flow or return pipe, and under conditions where probably no safety-valve would prevent it.

If the subject justified the interference of a Government Department, they should, I venture to think, have taken upon themselves the responsibility of formulating, after official inquiry, the safeguards and precautions best calculated to obviate the mischief.

Jan. 6, 1896. Another Secretary.

PARLIAMENTARY INTELLIGENCE.

PRIVATE BILLS (SESSION 1896).

Last Thursday was the limit of time allowed for depositing at the Private Bill Office memorials complaining of non-compliance with Standing Orders in the cases of the first hundred on the General List of Petitions for Private Bills for the ensuing session. On that day, memorials had been presented in respect of the petitions for the Sheffield Corporation Water Bill, the Southwark and Vauxhall Water Bill, and the Staines Reservoirs, &c., Bill. These measures will therefore encounter opposition at the initial stage. The petitions for the following Bills, which are among the first hundred, will not be opposed before the Examiners: Bexhill Water and Gas Bill, Birmingham Corporation Water Bill, Brighton Corporation (Shoreham and District Water-Works Transfer) Bill, Cheltenham Corporation Gas Bill, Cheltenham Gas Bill, Chester Corporation Bill, Cowes Gas Bill, Dublin Corporation Bill, East Surrey Water Bill, Eastbourne Water Bill, Edinburgh Extension Bill, Falkirk and District Water Bill, Fylde Water Bill, Huddersfield Water-Works Bill, Ilfracombe Gas Bill, Kent Water Board Bill, Kirkcaldy and Dysart Water Bill, Lanarkshire Water Bill, Leamington Corporation Bill, Malvern Link Bill, Matlock Bath Gas Bill, New River Company Bill, Padiham Water Bill, Porthcawl Water Bill, Portsmouth Borough Water Bill, Redheugh Bridge Bill, South Metropolitan Gas Bill, Whittington Gas Bill, Ystrad Gas and Water Bill.

Sales of Shares.—The following transactions in shares have just taken place: Fourteen fully paid £5 shares in the Matlock Bath Gas Company, paying 10 per cent., have changed hands at £10 5s. each; and 25 shares at £10 each. Fifteen fully paid £10 shares in the Matlock and District Gas Company have realized £23 10s. each for five, £24 each for five, and £25 each for five. About £100 fully paid £5 shares in the West Ham Gas Company have been transferred at an average price of £12 2s. 6d. each.

The Dvorkovitz Oil-Gas Process.—The "Bradford Observer" announces that a protest has been lodged at the Patent Office by the Northern Counties' Hydro-Oxygen Gas Company, of Huddersfield, against the patent of Dr. Dvorkovitz for "Improvements in apparatus for the treatment of liquid hydrocarbons, and the production therefrom of gas and valuable bye-products." Objection is taken by the Company to Dr. Dvorkovitz's patent on the ground that the invention infringes a patent already granted to them. The protest will come before the Comptroller-General in the usual form.

The Water Supply of the Ilford District.—The charge for water in Ilford and the district has been the subject of considerable local discussion lately. In this, as in another case which is just now engaging the attention of politicians here and across the Atlantic, it seems to be a question of boundary. The South Essex Water Company claim to have the right of supply in a certain area, which it is contended by some really comes within the district of the East London Water Company. The latter Company charge on the net rateable value of the property they supply outside the Metropolitan area, whereas the former charge on the annual value; and this really appears to be at the bottom of the trouble. As the result of several public meetings, it has been decided to raise a fund to have the whole matter investigated.

MISCELLANEOUS NEWS.

THE TESTING OF GAS-METERS.

At the Annual Meeting of the Justices of the Peace for the City of Manchester—the Lord Mayor (Alderman A. E. Lloyd) presiding—the subject of the testing of gas-meters was under consideration, on a report presented by the Gas-Meter Testing Committee. It consisted mainly of some "Notes on Gas-Meter Testing," by Mr. C. R. Bellamy, of Liverpool, and Mr. Dyson, of Manchester; but these were preceded by some observations by the Committee in regard to their work during the past year.

The Committee reported that they had, by visiting the testing offices, made themselves thoroughly acquainted with the work and requirements, and they testified to the efficiency and intelligence displayed by the Inspector and his staff. They then passed on to refer to the subject of proposed legislation in regard to the testing of gas-meters, and more especially to those of the prepayment kind. In considering this matter, they had been in co-operation with the Lighting Committee of the Liverpool Corporation and with Mr. C. R. Bellamy, their Superintendent. When the Select Committee on Weights and Measures was constituted, with Sir Henry Roscoe as Chairman, a communication was addressed to them suggesting that the testing of gas-meters was a matter which might well be included in their inquiry; but this view was not held by that Committee. Conferences and interviews followed; but owing to the changes caused by the general and municipal elections, nothing definite could be accomplished. Towards the close of the year, the Manchester Committee received a report from Messrs. Bellamy and Dyson, in which they pointed out that difficulties had arisen in connection with the testing of gas-meters owing to the introduction of the automatic prepayment system; there being no statutory provisions for testing the registering mechanism as well as the measuring chambers. The general practice was to test only the measuring chambers, and certify the meter in its entirety; and under this limited test, meters with accurate measuring chambers might register (say) 50 per cent. for or against the consumer, and be passed through an inspector's office without fear of detection. This long-standing defect in testing had, however, been accentuated by the introducton of prepayment meters. The reporters went on to say: "The demand for prepayment meters being very great, has led to the introduction of some very inferior ones, which in use frequently require their mechanism adjusted; and for this purpose, and also with a view to varying the purchasing power of the penny, the official seal is placed in such a way as to allow free access not only to the prepayment attachment, but often to the regulating gear of the measuring chamber. The certification of such meters was refused at the Liverpool office, and the matter brought under the notice of the Board of Trade through the Superintendent of the Weights and Measures Department. But it was decided that the matter could only be dealt with by means of a new Bill. Although the Liverpool inspector continues to refuse to stamp these meters, many thousands of them are certified by other inspectors and fixed in Liverpool. It appears very undesirable that the certification of an inspector should apply only to a portion of the meter, or that the official stamp should be attached in such a way as to permit of free access to the mechanism of the instrument. It would also appear of the first importance that there should be uniformity of action throughout the country on the part of the inspectors in dealing with gas-meters, and that suitable and compulsory rules should be framed from time to time as occasion demands by the Board of Trade for their guidance." Messrs. Bellamy and Dyson traced the progress of legislation from the passing of the Sale of Gas Act, 1859, the general provisions of which, they remarked, were still in force; being amended only by the short Act of 1860. The Committee pointed out that the Act gives inspectors power to refuse to certify defective meters of the types referred to. But they said there was the difficulty that the inspector who applied the full test would subject his office to loss of revenue, owing to the probability that meter manufacturers would send their meters to inspectors who were known to adopt the limited test.

In 1870, a Royal Commission appointed to inquire into the condition of Exchequer standards advised an entire remodelling of the Act. Their principal recommendations on gas-meter testing were as follows: "(1) That the duties of verification and inspection of gas-meters should be exercised according to instructions and regulations to be issued by the Board of Trade. (2) That no gas-meter should be regarded as legal that has not been reverified and restamped within a period of ten years. (3) That the comparison and verification of their indices or registering apparatus according to the official instructions of the Board of Trade be included. (4) That the fees for testing gas-meters and indices of gas-meters be regulated in pursuance of a scale to be notified from time to time by the Board of Trade. It was further stated that, "considering the whole of the existing system of verification and of inspection of weights and measures and of gas-meters, the great and principal defect appears to us to be the want of an efficient central control to give force and unity to local action, as pointed out in the report of the Select Committee on Weights and Measures in 1862; that without such control and authoritative direction there can be no adequate security for the public and for uniform administration of the law or a due compliance with its requirements, nor for the proper discharge of the duties imposed upon local authorities and officers. It would appear that if a Bill embodying the recommendations of the Commission could be passed, it would meet all the difficulties enumerated, and would, in addition, enable the Board of Trade from time to time to issue special instructions to the official inspectors as occasion demanded."

The Committee also caused inquiries to be made from about thirty gas-testing stations as to the charges paying expenses; and they only found three that worked at a profit—testing from 36,000 to 52,000 meters a year, against 12,000 meters for Manchester. On the 11th of December the Committee met Mr. Alderman Gibson (the Chairman of the Gas Committee), Mr. Alderman Higginbottom (the Deputy-Chairman), Mr. C. Nickson (the Superintendent of the Gas Department), and Mr. Whittaker (the Chief Inspector of Gas-Meters); the object being, if possible, to obtain the co-operation of the Gas Committee in their endeavour to obtain further legislation touching the testing of gas-meters and the charges for the same. It was agreed by all parties that a more efficient test for dry meters, and a revision of the charges, were desirable; and both Mr. Alderman Gibson and Mr. Alderman Higginbottom thought their Committee would support any application by the Justices to the Legislature with this object in view.

Alderman Gibson remarked, on the subject of the report, that the Gas Committee of the Manchester Corporation were desirous of associating themselves with the Justices in regard to the testing of gas-meters. They would be glad if the Board of Trade would adopt some system better than the present one; but as to the "penny-in-the-slot" meters, he maintained they were as much to be depended upon as any other meter. Those who used these meters were as fairly and justly dealt with as was possible. Mr. Bradley said that what was wanted was an extra guarantee that the meters were true. A person did not always get the quantity of gas he paid for by means of the slot meter. The inspector might perhaps find 10d. in the box, and yet the consumer had not had 10d. worth of gas. It was left to the inspector to return the extra money paid, or to allow its value in gas. Broadly speaking, he had no doubt the public were now getting what they paid for; but a year or two ago this was not the case. The meters were certainly getting more perfect.

The report was adopted.

THE MANCHESTER CORPORATION AND THE WORKING-UP OF GAS RESIDUALS.

Local Government Board Inquiry.

At Manchester last Wednesday, an inquiry was conducted by Colonel W. M. Ducat, on behalf of the Local Government Board, into an application by the Corporation for powers to utilize and manufacture, on ground at present forming part of the site of the Bradford Road Gas-Works, coal tar, coke, pitch, asphaltum, ammoniacal liquor, oil, and other residual products, and to sell and dispose of such products. Sanction was also sought to the borrowing of £25,000 (repayable in a period of 30 years) for this and other purposes connected with the gas undertaking. The proceedings of the Gas Committee in connection with this subject have been noticed in the "Journal."

Mr. Hudson, the Deputy Town Clerk, appeared in support of the application; Mr. Sutton and Mr. R. Richards opposed on behalf of certain property owners and ratepayers and of the Manchester and Salford District Property Owners' Association.

Mr. Hudson stated that the application was the result of long consideration on the part of the Gas Committee. They had visited other towns where the working up of the residuals was carried on; and they had decided to seek the powers now asked for. The matter was brought before the City Council in October last; and they unanimously resolved to apply to the Local Government Board for a Provisional Order. Similar powers were possessed, under Special Acts of Parliament, by Barrow-in-Furness, Birmingham, Bradford, Leeds, and Leicester; and the Local Government Board gave Salford the power to manufacture residual products in 1882. Similar powers had also been conferred, under Provisional Orders, upon Halifax, Rochdale, Blackburn, Birkenhead, Burnley, Coventry, Lincoln, Nottingham, Oldham, St. Helens, Stockport, Walsall, and Wigan, besides a number of non-county boroughs. If Manchester was entrusted with the desired authority, the Corporation would take care not to exercise their powers in an arbitrary manner, or in such a way as would cause a nuisance.

Alderman *Gibson* was called. He said the Gas Committee, of which he was Chairman, had had the question of the manufacture of sulphate of ammonia from ammonical liquor in their minds for the last twelve years; but it was only within the last year that the matter had been brought to a head. Various causes had tended to urge the Committee on, prominent among which was the reduction in the price of gas last year from 2s. 6d. to 2s. 3d. per 1000 cubic feet, involving a diminution of the profits by £50,000, and the abolition of meter-rents, which represented from £10,000 to £12,000 a year Under these circumstances, the Corporation thought it would be wise on their part to develop the resources which were in their possession, and to make the gas-works as remunerative as possible. The Gas Committee were satisfied that, by undertaking the work contemplated under the terms of the application, they would obtain a better and more profitable result than they would by continuing the present practice. In his judgment, the proposal was a reasonable, prudent, and suitable one; and they trusted it would receive the sanction of the Local Government Board. The Committee had carefully considered the question of nuisance to the neighbourhood; and they firmly believed no nuisance would attend their operations.

Replying to questions by Mr. Sutton and other gentlemen, witness stated that the Corporation were satisfied they would make more by manufacturing their bye-products than by selling the residuals. There were other chemical works in the neighbourhood; and they were more closely surrounded by property than the Corporation works would be. The Corporation certainly had no desire to do anything which would damage either Philips Park (which was their own) or anybody else's property. The land which was to be utilized was bought twenty years ago. It was a triangular piece of land, comprising about 11,600 square yards, and was said to be at a distance of at least 150 yards from any dwelling. It was true that Messrs. Hardman and Holden had for many years worked up the ammoniacal liquor produced by the Corporation. A pipe was laid from the gas-works to their works for the conveyance of the liquor; but he did not know they had paid the Corporation £2000 for it. He had received a letter stating that the firm were prepared to satisfy the Committee that they paid the Corporation the highest price for residuals. He did not know that they had been satisfied with an average profit of 3 per cent. on the tar and ammoniacal liquor obtained from the

Corporation, or that they made a serious loss in 1894. He thought the Corporation would get a Manager for the works for £200 a year.

The Rev. *S. N. Perry* and Mr. *G. Worthington* protested against the nuisance which they said would be created by the proposed works.

Mr. *Guymer* inquired whether, if the Corporation carried out this process without creating a nuisance, they would assist those living in the locality to suppress any nuisance arising from similar works.

Alderman *Gibson* said they would.

Mr. *G. E. Stevenson*, Gas Engineer to the Corporation, described the plant which it was proposed to erect, and stated that no nuisance would arise. He had had experience of such works at Peterborough and Buenos Ayres. The liquor could be taken from the Rochdale Road works by pipes, and from Gaythorn by barges. The returns for Birmingham, Bolton, Leicester, Nottingham, and Salford showed that they made larger profits out of ammoniacal liquor than Manchester did; and he believed the Corporation would find this undertaking profitable.

In cross-examination, witness said he did not think a Manager would be necessary; and in his estimates he had made no allowance for the cost of chemists and clerks. The work could be done by the present staff; and it was not necessary that their salaries should be increased because of it. The whole scheme would cost between £20,000 and £25,000. Questioned as to some statistics which he had put in, he said that, if they carbonized the coal to a very great heat, they obtained no tar; nothing but pitch. The Corporation had to make a considerable allowance to Mr. Holden on that account at the time of the strike. Another page of returns he had quoted from showed that Manchester took more out of their coal than Birmingham; and the latter should, in those circumstances, have more liquor.

Mr. SUTTON inquired if witness thought it was fair to omit mention of this when he spoke of other towns getting more out of their liquor than Manchester?

Witness said he had not noticed that there was so much difference. If he had known, it would not have been fair to have left it out.

Mr. SUTTON said he suggested that, having regard to the percentage of ammoniacal liquor produced, Manchester obtained a better price than Birmingham and Leicester, and that, although it appeared to get less than Nottingham, that was because Nottingham jumbled up the accounts, and charged the Gas Department generally with items which should go against the cost of manufacturing residuals. If he was right, Manchester was making considerably more by selling their ammoniacal liquor, without the risk or the expense of manufacturing sulphate of ammonia. This would satisfy Alderman Gibson at any rate that the present application should not be proceeded with.

Alderman *Gibson:* No; I think you are wrong.

Mr. *Stevenson* remarked that, if Manchester did better than the other large towns now, it would be in a still better position when it manufactured the bye-products.

Mr. SUTTON said that was not the correct deduction. It was because the other towns could not get the price for their liquor that Manchester obtained, that they commenced to work it up themselves.

The inquiry was, therefore, adjourned till Feb. 4.

INCANDESCENT GAS LIGHTING IN CHELSEA.

The Surveyor to the Chelsea Vestry (Mr. T. W. E. Higgens, Assoc.M.Inst.C.E.) has presented to the Vestry a report on the working of the ten incandescent gas-lights which he was instructed in April last to fix near the Town Hall by way of experiment. The report on which the instruction was founded was the third Mr. Higgens had made on street lighting. The ten lamps selected were in King's Road, and one in Sydney Street. They were fixed on the 18th of April, and from that date to Dec. 26 was a period of 36 weeks. In the first twelve weeks, 97 mantles were used; in the second, 35 mantles; in the third, 48 mantles. The total number used was 180—the lowest being ten, and the highest 32 in a lamp. Mr. Higgens remarks that when the number of hours of burning are taken into consideration, the improvement in the mantles during the latter portion of the period is more satisfactory than appears by the above statement. The number of hours during which the lamps were lighted was: First twelve weeks, 565; second twelve weeks, 725; last twelve weeks, 1187—total, 2477; or for the ten lamps (with the odd minutes added), 24,777 hours. For the first period the average life of each mantle was 58¼ hours of burning; for the second period, 207 hours; for the last period, 247½ hours. For the whole period, it would be 137½ hours. The number of mica chimneys used during the period was very small. He accounts for the large number of mantles used during the first twelve weeks partly to the fact that the men who light, extinguish, and clean the lamps were not accustomed to their use, and partly because the mantles were more brittle than they are now. The cost of the ten lamps (eight 4-feet lamps and two 12-feet lamps) for gas alone during 36 weeks would have amounted to £15 12s. 1d. If 8-feet burners had been on all the lamps, the cost would have been £22 6s.; and if 10-feet burners, £27 17s. 6d. The cost for the incandescent gas-burners, including mantles, chimneys, and extra labour, amounts to £22 8s. Mr. Higgens remarks, however, that it is not fair to the incandescent experiment to take the first part of their trial, when the men were learning how to use the mantles, &c. Taking the last twelve weeks, when the burners were in use for the longest time, the costs will be for gas: Ten lamps (eight 4-feet and two 12-feet burners), £7 9s. 8d.; if 8-feet burners on all lamps, £10 13s. 10d.; if 10-feet, £13 7s. 3d.; incandescent gas-burners, including mantles, chimneys, and extra labour, £8 9s. 11d. As regards the illuminating power of the incandescent burners, Mr. Higgens is of opinion that they are quite equal to an 8-feet, if not a 10-feet burner, although they burn less than 4 cubic feet of gas per hour. On the whole, therefore, he comes to the conclusion that the trial has been a success. The ten lamps during the last twelve weeks have cost £2 less than if the same illuminating power had been given by 8-feet burners. He therefore suggests that a further trial of 50 lamps for three months should be undertaken; and that, before recommending their adoption for all the main roads, a large number should be tried.

IMPROVEMENTS IN THE LIGHTING OF LIVERPOOL.

Following the changes which have been made in the constitution of the Lighting Committee of the Liverpool Corporation, some important improvements are to be effected in the lighting of the city. The initiative in this matter was taken by the Lighting Committee on the 13th of November, when they passed a resolution instructing the Gas Inspector and Superintendent of Street Lighting (Mr. C. R. Bellamy) to report as to the prevailing system of public lighting. This he did, and presented his report on the 20th ult.

Mr. Bellamy states that the total length of roads in the city is 414½ miles, of which 394½ miles are lighted by 12,240 lamps; 9467 being within the old city, and 2773 in the areas added under the extension scheme. In addition to the street-lamps, there are 1549 court and passage lamps; making a total of 13,789 lamps for all purposes. The average distance between the lamps in the old city is 52 yards; in the added areas, 75 yards—a mean average of 63⅓ yards throughout the new city. In 1886, a general survey of the lighting of the city was made; and it was decided that the lighting should be improved in all streets where the average distance between the lamps materially exceeded 80 yards. This has been carried out wherever practicable; and while the average distance between the lamps in some of the more important thoroughfares does not exceed 25 yards, there are very few instances in which it exceeds 80 yards within the old municipal boundary. Court lighting was commenced in 1880, with one lamp in each court; the qualification being that the court should contain the only entrance to a dwelling-house—this being the distinction, for lighting purposes, between courts and passages. In connection with this work, 2332 lamps were fixed, and 79 transferred from private owners to the Corporations making a total of 2411. It was feared at the time that these lamp; would involve considerable expense beyond that of the ordinary street-lamp, due to wanton damage and interference. But this view has been dispelled in practice; it being found that the court residents appreciate the lamps, and have safeguarded them against the common forms of damage, such as stone-throwing, &c. This has resulted in the maintenance charge being markedly lower than in the case of many of the ordinary street-lamps. Of the total number of court-lamps fixed, 979 have since been discontinued, owing to the demolition of property. The Corporation have never sanctioned the lighting of passages, except upon the recommendation of the Head Constable that it was necessary for police purposes; and therefore, out of an estimated total of 1815 passages within the city boundary, 117 only are lighted. There are in use 151 refuge, 235 urinal, and 36 tramway station lamps in the city.

As to the power and variety of the lamps, Mr. Bellamy reports that they comprise three kinds—ordinary, incandescent, and special. The ordinary lamps, which represent 94 per cent. of the total, are fitted with governor burners rated to consume 4 cubic feet of gas per hour; and they may be assumed to develop a light of about 15-candle power from the time of lighting to midnight, when the gas consumption is reduced to 2 cubic feet per hour. The incandescent lamps are variously fitted with one, two, or three burners, governed to consume 3 cubic feet per hour each, and yielding an average light of about 40 candles per burner. There have been 154 of these burners in use for more than twelve months; and it has been found that they develop, in practice, from a given quantity of gas, an average light about 3½ times greater than that of the ordinary street-lamp burner. Mr. Bellamy points out, however, that the adoption of the incandescent burner involves a heavy expenditure for maintenance, &c., which amounted in the year ended August last, to a total of £152 6s. 7d. If the equivalent value in gas of this sum is debited to the incandescent burners, the advantage is reduced to twice that of the ordinary burner. He also notes that this satisfactory result has been obtained principally in Lime Street, which is under the keenest police supervision; and, being very near to the offices of the Gas Department, it has been closely watched. Though the result of the year's work would appear to warrant considerable extension of the system, it must not, he says, be assumed that precisely similar results would be obtained on a larger scale. The special lamp constituting the third kind was designed in the department in 1883, in such a way as to provide for the reduction of the light at midnight to the power of the ordinary lamp; and 811 of these lamps have since been fixed. It consists generally of a combination of burners duly governed and fitted in lamps of suitable form, made of four sizes, nominally known as of 50, 100, 200, and 300 candle power. The first size is used for lighting the footways of the principal streets; and the three larger ones for the various refuges.

Prior to 1886, the annual hours of lamplight in Liverpool amounted to 3620. They had not, however, been arranged with due regard to the rising and setting of the sun; and complaint was made that at certain periods of the year lamps were lighted too late and extinguished too early. The system was accordingly re-arranged, and the hours increased to 3808 per annum, or 188 in excess of those under the previous scale. But with this addition the annual hours of lamplight in Liverpool were shown to be 38 less than the average of those adopted in ten of the principal towns in the kingdom. These hours do not apply to the lighting of the added areas.

The lamplighting work is carried out by 144 men, 36 of whom are employed in the added areas, whose duties have yet to be organized. The lighting of the lamps in the old city is carried out by 100 men and 8 foremen; the city being divided into 8 sections, and 108 districts. Each district is so arranged as to afford uniformly an hour's work; mileage being governed by the number of lamps. The men are paid at the rate of 25s. 8d. per week of seven days, with an extra day's pay per month in lieu of holidays, conditional upon the duties being satisfactorily executed. This raises the average weekly wage to 26s. 6d. The present system of lamplighting by Corporation workmen has been in operation for little more than twelve months; the work previously being in the hands of the Gas Company. In 1894, it was considered desirable to extend the system of reducing the power of the street-lamps at 11.30 p.m., which had hitherto been confined to the special lamps in the principal streets, to the whole of the city. The Gas Company's quotation for carrying out the additional work was

regarded as excessive; and, after inquiry into the system of lamp-lighting in Bootle and the other townships surrounding Liverpool, it was considered desirable to prepare estimates for carrying out the work by Corporation workmen. These estimates showed that, by taking over the work, the Corporation could carry out the three operations of lighting, reducing, and extinguishing the lamps at a lower cost than was being paid for the two operations of lighting and extinguishing only, and thus obtain the full benefit of the lower gas consumption. As efficient street lighting is so necessary for police purposes, the Head Constable was consulted on the general scheme; and a series of experiments were arranged in various parts of the city, and representative of the different businesses, residential, and other districts. These were continued for nearly six months, when it was decided to apply the scheme generally. A further alteration was made in May last year, when it was decided to light the lamps entirely at the lower rate for three months between the middle of May and August, and, in addition, for a period of one week about the time of full moon in each month throughout the year. The first part of this arrangement was carried out satisfactorily; but the reduction of the power of the lamps during the periods of assumed moonlight was found, as the evenings lengthened, to be attended with difficulty, and, on the verbal instructions of the Committee on the 14th of October, it was suspended. The time of the reduction of the power of the ordinary street-lamps, which was formerly fixed at eleven o'clock p.m. and completed at midnight, was found to be too early; and on the 16th of September it was decided to defer the work for half an hour—the commencing time being fixed at 11.30 p.m. Moreover, in reviewing the scheme generally, Mr. Bellamy, is of opinion that the reducing of the street-lamps of every description should not commence before midnight; and that the lighting of the lamps on the lower rate for one week about the period of full moon should be discontinued entirely.

On the 6th ult. the Lighting Committee further instructed Mr. Bellamy to prepare a "list of streets in the old municipal boundary in which the average distance between the lamps exceeds 50 yards and over, 75 yards and over, and 100 yards and over." This he did, and presented it on the 20th ult. The tabulated particulars furnished by him show that the average distance between the lamps is less than 50 yards in 136 miles of streets, and more than 50 yards in 140 miles. At the request of the Chairman of the Committee, he prepared an estimate of the cost of reducing the average distance between the lamps in the 140 miles of streets to not exceeding 50 yards, together with an apportionment showing the annual charges, assuming the work to be spread over a period of four years. He reported that to carry out the work would involve the erection of 996 lamps, the first cost of which, together with the necessary removals and alterations, would amount to £4257 18s., while the annual maintenance charge (at present prices) would come to £2348 18s. By spreading this expenditure over four years, the following would be the annual outlay: First year, £1651 14s.; second year, £2238 18s. 6d.; third year, £2826 3s.; fourth year, £3413 7s. 6d. In the fifth year, the expenditure on the work and material having been completed, the charge would be £2348 18s. (at present prices), which would remain permanent under the scheme.

At the meeting of the Lighting Committee on the 20th ult., the estimate of the expenditure on account of public lighting for the year 1896 was considered. It consisted of the following items: Public lighting in the old city, £29,263; new lamps, £722; alterations and repairs, £2218; lighting added areas (including additions and renewals), £7914; salaries, rent, &c., £2867—total, £42,984. The estimate also contained allowances as follows: Increased lighting of main thoroughfares, £2591; additional lamps in secondary and bye streets to reduce the average space between the lamps to a maximum distance of 50 yards, £1652; lighting of passages, £1058; extension of hours of lighting in added areas, £1132—together, £6433, which brings the total up to £49,417. The electric lighting estimate is £550. The estimate was approved; and it was referred to the Finance and Estate Committee to be included in the estimates for the general rate.

The following summary of the resolutions of the Lighting Committee were submitted to the Council last Wednesday: "(1) As it appeared from the report of the Gas Inspector that, under the resolution of the Committee, the reduction in the power of the lighting in the city was required to be commenced at 11.30 o'clock each night, and finished at 12.30, it was resolved that in future the full power of light be continued until midnight, and that the reduction of the whole city be then commenced, to be completed by one o'clock a.m.; the additional cost of gas for the increase of lighting being estimated at £500. (2) With a view to improving the lighting in the secondary streets, a return was ordered of the mileage of streets where the gas-lamps exceed an average distance of 50 yards apart; and the resolution of the Committee provides for a gradual increase to be made in the number of lamps in the city, so that in no street shall the interval between lamp and lamp exceed an average of 50 yards. The cost of this work and necessary material is estimated at £4257, which will be spread over four years. The annual increase in the consumption of gas prevailing last year is estimated at £2348 18s. (3) Upwards of 1700 passages in Liverpool are, from the returns of the Gas Inspector, unlighted; and the Committee have recommended that the lighting of 900 of these places be proceeded with, to be completed during the next four years, at an estimated cost of £3176, and with an annual cost for gas of £1651. (4) A further recommendation of the Committee is to improve the lighting within the old city, of the main thoroughfares leading from the new districts into the heart of the city; also to extend the improved lighting to a considerable number of the more important streets in the centre of the city, a list of which is set out in the Gas Inspector's report—the estimated cost of the work and material amounting to £1023 13s. 3d., and the additional annual cost to £1409 19s. 3d. (5) As regards the lighting of the recently-added area, the Committee have resolved to apply, with the necessary modifications, the principle of the lighting adopted within the city to these districts, and also to place the lamplighters engaged in the duties in a similar position, as regards pay and work, to those employed in the older city. This involves a considerable addition to the pay and hours of the men engaged; but it makes uniform the system which varied considerably from district to district."

Mr. Petrie, the Deputy-Chairman of the Committee, in moving that the lighting estimate for 1896 be approved, explained that, among other things, the Committee proposed to increase the time during which the public lamps gave full light, involving thereby an additional expenditure of £1300. Moreover, in some streets the average distance between the lamps was 80 yards; and the Committee intended to reduce it to 50 yards. They did not purpose spending the whole of the money this year, but to spread it over four years. Another matter they had gone into was the lighting of the passages and courts of the city. It would probably be news to a large number of members of the Council to find in the reports of the gas inspectors that something like 1700 or 1800 passages in the city were not, and never had been, lit up; and there was no doubt that it was very material to the work of the police in detecting criminals that these passages and courts should be lighted. Their darkness had given rise to a considerable amount of pilfering. They also intended dealing with some of the main thoroughfares leading into the city. Although the estimate was nearly £15,000, yet he thought the Council would say that, for upwards of 400 miles of streets, this was not an exorbitant sum for giving efficient lighting to such a large city. The motion was seconded by Mr. Dean. Alderman F. Smith complained that the Lighting Committee had not given any explanation as to their change of policy, which now seemed to be one of spending money without considering the needs of the city. In closing the discussion, which was a short one, Mr. Petrie said the Committee were trying to effect some arrangement with the Gas Company; and he hoped that, within a very short time, they would be able to get some reduction in the price of gas, and bring a report before the Committee and the Council. They were pursuing a right policy, and one called for by general agitation. Incandescent gas lighting was making great progress; but it was not altogether an unmixed blessing. In Lime Street on the night of the recent storm, no fewer than 150 lights were blown out; and it was quite impossible to re-light them. Until some very great improvement had been made in the incandescent light, he did not see how they could light the city with it. He thought Liverpool ought to be one of the best lighted cities in the kingdom. The estimates were passed.

METROPOLIS GAS SUPPLY.

Dr. Williamson's Quarterly Report.

The following is an extract from the report of Dr. A. W. Williamson, F.R.S., the Chief Gas Examiner for the Metropolis, on the quality of the gas supplied during the quarter ended the 31st ult.

I. *With respect to Illuminating Power.*—The average in standard sperm candles at each of the testing-places was as follows:—

The Gaslight and Coke Company—	
106, Fenchurch Street, E.C.	16·5
10, Kinghorn Street, E.C.	16·5
1, Dorset Buildings, Salisbury Square	16·6
21, Millbank Street, S.W.	16·4
123, Ladbroke Grove, W.	16·4
3, Vincent Terrace, Islington	16·4
1, Carlyle Square, Chelsea	16·1
170, Camden Street, N.W.	16·3
14a, Graham Road, Dalston	16·7
47, Kingsland Road, N.E.	16·5
Spring Gardens, S.W.	16·3
1, Vinery Villas, St. John's Wood	16·1
116, Lambeth Road, S.E.	16·1
121, Hornsey Road, N.	16·3
66, George Street, Hampstead	16·5
Commercial Gas Company—	
6, Wellclose Square, E.	16·3
24, Parnell Road, E.	16·2
South Metropolitan Gas Company—	
104, Hill Street, Peckham, S.E.	16·6
37, Bedford Road, Clapham	16·3
1, Stoney Lane, Tooley Street	16·7
180, Lewisham Road, S.E.	16·2
99, Blackfriars Road, S.E.	16·3
211, Burrage Road, S.E.	16·4

It will be seen from these results that the average illuminating power of the gas has been higher than the parliamentary standard of 16 candles at all the testing-stations.

II. *As regards Purity.*—The average amount of sulphur present in the gas at all the testing-stations has been considerably less than the limit of 22 grains allowed; and especially at the Millbank Street and Ladbroke Grove stations of The Gaslight and Coke Company, the two stations of the Commercial Gas Company, and the Hill Street station of the South Metropolitan Gas Company, at which testing-places it was less than half the quantity permitted. The limit allowed was not exceeded on any occasion during the quarter.

Ammonia has been generally present in the gas throughout the quarter—but only in slight quantities—at all the testing-places. The limit allowed (viz., 4 grains) was not exceeded on any occasion.

The Graham Road station of The Gaslight and Coke Company was re-opened for testing purposes on Oct. 30; and the Ladbroke Grove station of the Company was closed for cleaning on and from Dec. 18.

The Tilehurst and Pangbourne Water Order.—The application of the Tilehurst and Pangbourne Water Company for a Provisional Order to enable them to extend their limits of supply, raise additional capital, &c., was under consideration at the meeting of the Henley Highway Board last Tuesday. The Chairman (Mr. E. Whitehead) said complaint had been made as to the manner in which the Company had done their work in restoring the roads on the Berkshire side of their statutory area. But the Company's Solicitor (Mr. D. H. Witherington) pointed out that the Company were bound to reinstate to the satisfaction of the local authorities all roads which had been broken up. A letter was read from the Whitchurch District Council in support of the Order; and a motion sanctioning the application was agreed to.

THE GAS AND WATER ORDERS OF THE PAST SESSION.

The Board of Trade report on their proceedings under the Gas and Water Works Facilities Act, 1870, during the past session was issued last week. It states that in December, 1894, eleven applications for Provisional Orders were made to the Board—six relating to gas, and four to water undertakings, and one to a combined gas and water undertaking. Power was sought to raise £127,500 by shares and £32,375 by loan, whereof £82,000 share and £21,000 loan capital related to gas, and £45,500 share and £11,375 loan capital to water undertakings.

Five of the applications for Gas Orders were in respect of undertakings already authorized by Parliament—viz., Barnstaple, Bognor, Kildwick Parish, Newark, and Rothwell. The Barnstaple and Kildwick Parish Gas Companies applied for power to raise additional capital; the Bognor Gaslight and Coke Company, Limited, to construct additional works for the manufacture and storage of gas; the Newark Gas Company, to raise more capital, extend their limits of supply, and construct and maintain additional works; and the Rothwell Gaslight Company, to purchase lands and extend their limits of supply. The application for the Felixstowe Gas Order related to an undertaking already existing without parliamentary authority, and sought for power to maintain and continue the existing works and the manufacture and supply of gas.

Objections were lodged against some of the applications; but, with certain modifications and amendments, the Board of Trade granted an Order in each case. In that of Newark, some of the local and road authorities objected; and others withheld their consent to the application. Objections were also lodged by owners of land adjacent to the site of the proposed works. The Board of Trade appointed Major F. A. Marindin, R.E., C.M.G., to hold a public inquiry at Newark, and to report to them in the matter. They subsequently decided to grant the Order; and, in compliance with section 4 of the Gas and Water Works Facilities Act, they made a special report to Parliament thereon.*

The sliding-scale of price and dividend was adopted in the Newark and Bognor Orders; the initial price per 1000 cubic feet being fixed as follows: Newark, 2s. 11d. within, and 3s. 5d. beyond the borough; Bognor, 4s. 1d. In the following Orders, a maximum price per 1000 cubic feet was fixed; power being reserved to the Board of Trade to vary it, or to substitute a sliding-scale, after three years: Felixstowe, 5s. 3d.; Kildwick Parish, 5s.; Rothwell, 4s. 9d.

The supply of gas in bulk beyond the district, subject to the usual limitations, was authorized in the Felixstowe and Newark Orders. The Orders also contained the usual clauses as to the sale of additional capital by auction or tender, limits of dividend, the creation of insurance and reserve funds, illuminating power, testing of gas, the quantity of land to be taken by agreement, &c.; and, where necessary, the Gas-Works Clauses Acts, 1847 and 1871, were incorporated.

The application of the Llanberis Water and Gas Company, Limited, related to gas and water undertakings which already existed without parliamentary authority. Objections were lodged against the application by the several local authorities concerned, and by certain private individuals. The Board of Trade accordingly appointed Lieut.-Col. H. A. Yorke, R.E., to hold a public inquiry at Llanberis, and to report to them on the matter. Subsequently, upon consideration of Colonel Yorke's report, the Board decided to grant an Order; and, in compliance with the Act, they made a special report to Parliament thereon.* The Order, as made by the Board, fixed the maximum price for gas at 5s. per 1000 cubic feet; power being reserved to the Board to vary it, or to substitute a sliding-scale, after the expiration of three years. The Company were also authorized to supply water in bulk by agreement, within or beyond the limits of supply. A clause was inserted in the Order empowering the Local Authority to purchase the gas and water undertakings, or the water undertaking only, at any time within six months after the commencement of the Order.

Two Bills to confirm the Gas and Gas and Water Orders were introduced into the House of Lords on the 2nd of May. They were suspended at the dissolution of Parliament, but were proceeded with in the first session of the new Parliament; and at the date of the report [Aug. 31, 1895] they were awaiting the Royal Assent. [This was given on Sept. 5.]

Four applications—from Holyhead, Mid-Kent, Newton Nottage, and South Hayling—were made in regard to water. The Holyhead application was for power to construct additional works and raise further capital; the Mid-Kent, to authorize additional works, extend the limits of supply, and raise further capital; the Newton Nottage, to authorize the maintenance and continuance of existing works and supply of water; and the South Hayling, to sanction a new undertaking. The aggregate amount of capital proposed was £41,500 by shares and £9375 by loan. An Order was made in each case, except that of Newton Nottage.

The consents of two of the local authorities were not forthcoming, in the case of the Mid-Kent application, and Lieut.-Col. Yorke, R.E. was appointed to hold a local inquiry, and report whether or not such consents might be dispensed with. He reported that, in his opinion, it would be to the interest of the locality that the Order should be granted; and the Board of Trade accordingly dispensed with the consents, and made the Order, with an amendment intended to expedite the supply of water in the new district by the Water Company. In this case, also, a special report was made to Parliament.* The Newton Nottage application was opposed by the Local Authority; and Major Marindin was appointed to hold a local inquiry. On consideration of his report, the Board of Trade decided not to proceed with the Order.

A Bill to confirm the Water Provisional Orders was introduced into the House of Lords on the 2nd of May; and, meeting with no opposition in either House, received the Royal Assent on July 6.

The total number of Orders made by the Board since the passing of the Act is 401, of which 395 have been confirmed by Parliament.

* These reports were given in the "JOURNAL" for June 18, 1895 (p. 1321).

THE NEWCASTLE-ON-TYNE CORPORATION AND THE GAS COMPANY.

Complaint as to the Charge for Public Lighting—Proposed Opposition to the Company's Bill.

At the Meeting of the Gas and Water Committee of the Newcastle Corporation last Tuesday, there was a long discussion concerning the application of the Gas Company to Parliament for increased powers in the lighting of the city and district. It was pointed out that dissatisfaction had existed for a considerable time in the Committee, on account of the Corporation having to pay £2 10s. per annum for each lamp used for public purposes in the streets—a sum fixed upon when gas was charged to private consumers at the rate of between 4s. and 5s. per 1000 cubic feet; whereas, at the present time, private consumers, after deducting discount, paid about 1s. 8d. per 1000 feet, but no reduction had been made regarding the lighting of street-lamps. The Corporation paid the Company £15,000 per annum for public lighting; and if certain concessions were made, there would be, it was estimated, a difference of between £3000 and £4000 a year in favour of the Corporation. Fault was found with the illuminating power of the gas; but for this, it was understood, the Company had assigned reasons, and further declared that this drawback would in the course of time be overcome. It was ultimately arranged that a special meeting of the Committee should be held to take into further consideration the grievances of the Corporation, and that, in the meantime, the Town Clerk should take the necessary steps for the Corporation to have *locus standi*—if need be, and if no friendly arrangement had been come to—in opposition to the Company's Bill.

THE QUALITY OF CHELTENHAM GAS.

Among the minutes submitted by the Lighting Committee at the meeting of the Cheltenham Town Council yesterday week, was one referring to the report presented by the Gas Examiner in December. In this, attention was directed to "the great average inferiority of the gas as tested in the town to the gas as tested at the gas-works—viz., 1·615 candles;" and with regard to tests taken on Nov. 22, the Gas Examiner remarked as follows: "The gas as tested in the town appeared to be better than the gas as tested at the gas-works by 0·21 candle. To understand how such a result may occasionally occur, it is necessary to bear in mind that an interval of at least an hour must always elapse between the times of beginning the two tests; and that thus there is always the possibility of an actual change in the quality of the gas occurring in the meantime. But as such changes may count either way, they disappear on taking the average, as also do accidental variations in the power of the candles." The minutes were submitted for approval by Alderman Norman, who, dealing with the Gas Examiner's report, observed that that official had taken more tests than usual, and that there was a rather remarkable difference between the tests taken at the gas-works and at the Corporation testing-station. On only one occasion out of six, had the illuminating power at their station been above 16 candles; and once it was as much as ¾ candle below the minimum laid down by the Company's Act—viz., 15 candles—the illuminating power on Dec. 23 being only 14·28 candles. He thought the Company would allow him to say, without unnecessary offence, that the report of the Examiner was borne out by the experience of the town, and that the gas had not been of the standard which the consumers in such a town had a right to expect. He trusted the Company would endeavour to give householders gas of better quality. The Examiner had shown that on one occasion the gas, as tested at the Corporation station, was of greater illuminating power than that tested at the gas-works; and there could be no doubt—as the late Examiner as well as the present one had pointed out—that there was frequent variation in the quality of the gas, and that the results obtained depended very considerably upon the exact moment at which the tests were made. The minutes were confirmed.

THE LOCATION OF "PENNY-IN-THE-SLOT" METERS.

Complaints have been made at various times as to the ill-treatment to which gas-meters are subjected by being stowed away in cellars or inaccessible places which render their inspection difficult. But, as far as we are aware, no personal injury has resulted, except perhaps a slight one occasionally to the "gas-meter man," for whom no very great sympathy would be shown by the consumer. Now, however, that prepayment meters are being extensively adopted, it is necessary that special attention should be given to their location, so that the consumer, when making his periodical visits to the meter to drop in his penny, should be put to as little trouble as possible, and should certainly not run any risk of bodily suffering. These remarks are called forth by a report which appeared in the papers last Tuesday of an inquiry held by Mr. G. P. Wyatt in Peckham, on the previous evening, in regard to the death of a music-hall dancer named Elizabeth Margaret Lawes, which occurred on the previous Friday evening under peculiar circumstances. According to the evidence, a penny had been put into the gas-meter, which was upon the landing outside the room occupied by deceased; but, the light being defective, she went out to rectify it. Almost immediately afterwards, a "thud" was heard; and it was found that she had fallen over the balusters into the passage beneath, and was bleeding from a wound on the head. The Coroner inquired how she came to fall over; and the witness replied that the meter had been placed very high over the door, and, in order to reach it, deceased would have to stand on a "property" basket which was on the landing. It was a most dangerous position for the meter. He added that he had heard of many accidents of the same kind—in fact, the doctor who was called in to attend deceased told him that he had lately visited three persons who had fallen while attempting to reach their meters. He (witness) thought that, when standing on the basket, which was about a foot

lower than the balusters, deceased overbalanced, and fell backwards. The landlady testified that the meter was very high; her husband, who stood more than 6 feet, not being able to reach it without standing upon something. The doctor who had been called in stated that he found deceased paralyzed and in a condition of collapse, and, in his opinion, her neck was broken. The cause of death was shock consequent upon a fractured spine. Verdict, "Accidental death."

LEAKAGE OF GAS FROM A FRACTURED MAIN IN THE CITY.

Some excitement was caused in Lime Street, City, just before ten o'clock on Monday morning last week, by the detection, by a police-constable on duty, of a serious escape of gas opposite Nos. 24 and 27. The Gaslight and Coke Company were at once communicated with; and a gang of men from the Goswell Road station were promptly on the spot. The gas having been cut off from the shops in the immediate vicinity, the ground was opened. During the operations, the escaping gas became ignited and caused some commotion; but it was soon extinguished with sacks. A second outbreak occurred about three hours afterwards; and, being more serious, the services of the Fire Brigade had to be called in to quell it. After the Company's men had been at work for nine hours, the fractured main was discovered; and it was found that, owing to an extensive subsidence of the ground beneath, leaving a cavity large enough for a man to crawl into, the pipe had been left without support. The main was immediately plugged on either side of the fracture; work being continued till about midnight. On the following morning, a new main was substituted, and the supply of gas renewed.

PREPAYMENT GAS-METERS AT NOTTINGHAM.

A representative of the "Nottingham Express" has had an interesting chat with Mr. W. R. Chester, the Engineer and General Manager of the Gas Department of the Nottingham Corporation, on the subject of prepayment meters; and he embodied the information he gleaned in an article which appeared in our contemporary last Wednesday. The writer fully explains the working of the system, and says a good deal as to its usefulness. The Nottingham Gas Department seems to have suffered, in a large degree, from the return of meters in hard times. "In the year 1888, it was found that some 3000 meters had been returned to the Corporation, which meant that there were not only 3000 consumers less in the borough, but that there were almost as many bad debts on the books." It was the recognition of the severe loss sustained by the return of so many meters by people who were unable to meet their bills, that induced Mr. Chester to recommend his Committee to give the prepayment meter a trial. A start was made with 25 meters, and an inspector was sent to interview the same number of people, who had from stress of circumstances been compelled to cease consuming gas. In almost every case, these people agreed to take a meter, and so allow of the experiment being made. It was sufficiently successful to induce Mr. Chester to increase the number; and soon the demand became more than encouraging. Although not a single order was solicited, upwards of 600 were fixed during 1891, and they have been put in at about this rate per year ever since. So that now the Corporation have back the 3000 consumers who went off their books in hard times. The price which the Corporation charge for gas is 2s. 6d. per 1000 cubic feet; and though the penny-in-the-slot meter increases this to 3s. 4d., the extra cost is more apparent than real. In reality (the writer in our contemporary says) it works out to about the same as the ordinary meter supply; for, with the prepayment meter, there is no meter-rent, no charge for fixing, and no extra demand for the increased cost of the new meter, which is just double that of the old one.

LOANDA GAS COMPANY, LIMITED.

The Second Annual General Meeting of this Company was held at the offices, New Broad Street, E.C., on the 20th ult.—Mr. A. Fairlie in the chair. The Manager and Secretary (Mr. A. F. Baillie) read the notice convening the meeting, and subsequently the Directors' report. We learn therefrom that a great portion of the plant and material required for the construction of the works has been delivered at Loanda; and the Municipality having placed the Company's representative in possession of the land conceded to them, the buildings are now being erected. The latest reports from Loanda are stated to be of a most satisfactory character. The parties acting for the Company there are a highly respectable firm, who display the greatest interest in the advancement of the undertaking. These express the opinion that the sale of coal and coke will exceed all returns that have been anticipated. In order to be first in the field, the construction of a wharf for the discharge and embarkation of goods has been commenced; and application has been made to the local authorities for certain rights in connection therewith. The Directors are encouraged by the fact that the Portuguese colony at Angola is fostered by the Home Government, and that the ancient city of Loanda—one of the earliest foundations on the west coast of Africa—is making rapid progress, and is permitted to retain for its permanent improvement a large portion of the revenue accruing from import, export, and other dues, all of which are carefully administered by the municipal authorities. The payment of interest on the Company's debenture bonds has been maintained; but as the works are still in the Contractors' hands, the Directors have deferred the presentation of any accounts until they are completed. The Chairman moved the adoption of the report; and the motion was unanimously agreed to. Thanks were accorded to the Company's Agent in Lisbon (Mr. E. P. Vidal), as well as to the Directors and Manager, for their attention to the Company's interests.

ELECTRIC LIGHTING NOTES.

The question of the lighting of the Free Library has been recently discussed by the Rochdale Town Council. As is usual in dealing with this subject, all the well-worn assertions were trotted out. Gas was charged with attacking the bindings of the books, vitiating the atmosphere, and raising the temperature excessively, all of which evils the electric light would cure. The debate was raised on a motion by Mr. Fishwick that the Council make application to the Local Government Board for sanction to borrow £500 for the purpose of lighting the Free Library by electricity; and the matter is only worth notice here on account of one or two interesting points in the proposer's remarks. In referring to the question of temperature, he alluded to some tests that were made on Dec. 16. He said that before the gas was lighted, at 5 feet from the floor, the temperature was 55°, and at 10 feet above the floor, it was 54°. When the gas was partially lighted at four o'clock, the temperature rose to 58° on the floor; and 65° 10 feet above the floor. At six o'clock, when the gas was full on, 60° were registered on the floor, and 70° 10 feet above the floor-level. At eight, o'clock, there was a rise to 73° at the higher level; and at nine o'clock when part of the lending library was closed, and the light consequently diminished, the temperature on the floor still remained at 64°, while 10 feet above the floor it dropped to 66°. Mr. Fishwick did not think it could be denied that such a heat injured the books; but without information as to whether the heating arrangements continued constant during the period in which the tests were made, and as to whether or not there was an increase in the number of visitors, the figures are of little value. Passing on to the portion of Mr. Fishwick's remarks in which the kind of installation it was proposed to adopt was explained, he stated that the Southampton Free Library was a parallel institution with their own; and he found that there, although they had an Electric Light Company in the town, the Library Committee established an installation of their own, and lighted the library very successfully, at a cheaper rate than they had previously done by gas. A scheme had been worked out under which the outlay for a dynamo and gas-engine to work the apparatus at their own library would cost £450. The annual cost would be about £100 a year; and the expense for gas was now £75. But this annual cost would include the repayment of the £500 it was proposed to borrow. The odd £50 would be required to work a fan for ventilating purposes. The £100 a year would include the supply of gas to the engine, oil, and everything required, and also a tenth part of the amount borrowed. The motion was seconded; and later on the Chairman of the Gas Committee (Alderman W. J. Petrie) gave it support—remarking that he thought this a nice opportunity for the Corporation to have an installation of the electric light in their hands, and so gain knowledge from experience. The important question as to ventilation was raised by Mr. Cheetham, who believed that, if a ventilating-fan (which, it appeared, would be required with the electric lighting plant) was now introduced, there would not be the variations of temperature mentioned by Mr. Fishwick. The motion was unanimously agreed to.

The Lincoln City Council have refused their consent to the Provisional Order for which the County of London and Brush Provincial Electric Lighting Company, Limited, have given notice of their intention to make application to the Board of Trade. The Company seek power to produce and supply electricity in Lincoln; but, after hearing statements from representatives, the Lighting and Improvement Committee and the Gas Committee jointly decided to recommend the Council to appoint a Special Committee to consider and report upon the advisability of themselves providing a supply of electricity for the city. This the Council agreed to, and also gave the Committee permission to consult a professional electrician.

Not only is the current in St. Pancras as unreliable as elsewhere, but another little drawback was mentioned at Wednesday's meeting of the Vestry by Mr. Harrison, who plaintively inquired why, when extra voltage was "put on" a fortnight since, so many of the lamps burst. As no answer was vouchsafed, Mr. Harrison demanded a report as to the number of destroyed lamps; and the Committee agreed to furnish it. The subsequent action of the Vestry rather implies that the new Chief Electrical Engineer finds his hands too full; for it was decided that "a responsible officer, to be called 'Distributing Engineer,' be appointed, whose time shall be devoted to the duties of inspecting and testing the whole of the Vestry's electric mains, &c., and all duties incidental to their being kept in a satisfactory condition, and to be responsible to the Chief Electrical Engineer for their proper maintenance and condition, for the purpose of ensuring an uninterrupted supply of current to consumers and for public lighting." If this new official (one of the assistant engineers at a branch station was appointed) succeeds in ensuring "an uninterrupted supply of current to consumers," he will not only have fairly earned a gratuity of £12 10s., which the Vestry, after a lot of haggling, decided to grant him for a provisional period of three months, but will certainly be entitled to the gratitude and esteem of all users of electricity throughout the United Kingdom. To return, however, to the more prosaic features of the incident, will not the responsibility involved in maintaining "the whole of the Vestry's electric mains" by this assistant strip the office of Chief Electrical Engineer of its principal duty?

In the face of the recent action in recommending a reduced charge for current supplied to churches, it is strange to find the Electricity Committee of the Vestry recommending that no exception be made in the case of the University College Hospital. When it is remembered that the patients who were injured by the explosions in the conduits last winter were carefully tended at the institution, this is all the more remarkable. But the ingratitude of public bodies is notorious. It should, however, be mentioned that the Vestry did not wholly agree with their Committee's recommendation in this matter, which has been again put back for further consideration, mainly through the eloquent appeal of Mr. W. J. Wetenhall on behalf of all London hospitals.

Another stage has been reached in reference to the proposals for supplying electricity in Plymouth. The Committee appointed some months ago to make inquiries have now concluded the round of visits, which was irreverently described in anticipation as a "glorified picnic,"

and have presented to the Borough Council a long report. They visited Bristol, London, Brighton, Portsmouth, and Taunton; and, as the result, they came to the not unexpected decision that electricity ought to be supplied in Plymouth, and that the Corporation, under the powers they possess, should keep control of the supply. They are, moreover, of opinion that Plymouth possesses advantages for establishing electric light works which are not to be found in some, if any, of the places visited. The chief of these advantages is that the land owned by the Corporation, and already designated as the site of the central station, is of such a character that no costly foundations for buildings will be necessary; while it is near the water side, which will enable fuel to be brought into the premises at a low cost. There is likewise a supply of water in the hands of the Corporation for condensing purposes. Their recommendations are grouped under seven heads. One of these—that the Corporation should themselves put in force the powers they have obtained for the supply of electricity—has already been referred to. They also say that, in their judgment, the reports recently presented to the Council, together with their own, furnish all necessary material for arriving at a decision on the main points to be determined. The central station should, they say, be so designed that the waste heat from a refuse destructor may be utilized if hereafter found desirable or feasible—a point as to which Dr. J. A. Fleming, the expert who reported on the subject some months ago, expressed considerable doubts. They also propose that electricity for traction purposes should be supplied from the same station. Here, again, they are in apparent opposition to Dr. Fleming, who, though not opposed to the use of the same station for the two purposes, pointed out that separate plants would be necessary for the lighting and working the tramcars. With regard to lighting, the Committee recommend that the public lighting of the Hoe, the chief places of resort, and the principal streets, should be at once undertaken. They are of opinion that the Corporation should not at this stage tie themselves to any consulting engineer, manufacturer, type of engine, or plant. Instead, they recommend that an engineer should be appointed at a salary of £300 per annum, rising by four equal increments to £400 per annum, and "that in this way the commissions usually paid during construction should be saved, and the services of a competent man, fully conversant with every detail of the undertaking, and practically interested in it, secured." It is further suggested that, immediately on his appointment, the electrical engineer, "unfettered except in so far as these recommendations are concerned," should be instructed to prepare a scheme for supplying electricity for power and lighting, with a view to steps being taken to obtain the necessary borrowing powers. One other result of the Committee's visits was to convince them that the overhead system, as applied to tramcar traffic, is "safe, convenient, clean, and economical," and will not more disfigure the streets than do the existing telegraph and telephone wires, and cause less offence to good taste than is occasioned by signboards and other forms of advertising. On this point they are likely to encounter considerable difference of opinion in the town, where the ratepayers are now spending enormous sums in widening narrow thoroughfares. One other statement of the Committee is worth quoting *in extenso*, and is especially interesting in view of the low price at which gas is supplied in Plymouth. It is that "the ratepayers should derive a profit from the undertaking."

THE SITUATION AND PROSPECTS OF THE COAL INDUSTRY.

The following is the article on the above subject which recently appeared in "The Times," and formed the basis of the first of our "Editorial Notes" last week:—

The coal-mining industry of Great Britain has seldom had a more unsatisfactory year than that which has just concluded. The price of coal has fallen almost continuously during the twelve months, until now it is, over a large part of the area of supply, from 10d. to 1s. 2d. per ton under the average prices of a year ago. In other words, the average price of coal at the close of the year is lower than the price that has been current at any time during the last seven years. It is not difficult to estimate what this condition of things means to the coalowner. The total production of coal in the United Kingdom in 1895 was probably about 190 million tons, which would only be assuming two million tons more than the ascertained output of 1894; and a difference of 1s. per ton on this quantity would, of course, represent a reduced income of close on ten millions sterling on the output of the year, if all charges on output had remained the same. The latter condition has not been fulfilled. The wages of miners have, in a good many cases, been reduced. In Scotland, for example, the average nominal wages paid to miners have been lowered from 5s. to 4s. 6d. per day; and in some other districts important reductions have been made since the latter part of 1894; but, as against these, the cost of stores has, in a number of cases, been increased. Pig iron has been advanced by about 5s. per ton all round; steel beams, girders, &c., have been advanced by 3s. 6d. to 7s. 6d. per ton; and other items that enter into the varied and nondescript category of colliery stores have also had to be purchased at higher prices, in consonance with the upward trend of values generally. Coal, however has remained at a low price, because it is a drug on the market.

During the years 1890 to 1892, a considerable number of new collieries were opened, especially in South Wales, Yorkshire, and Derbyshire; and where the coal industry was otherwise working under normal conditions, these new pits greatly added to the output, until it became necessary over a very large area of mining operations to limit the output by working the pits for a reduced number of days in the week, according as the demand was brisk or stagnant. This system is always a costly one. The great secret of economical production is to work on a large scale. Supposing the average cost of producing a ton of coal to be 5s., it will be found, in a general way, that 3s. of this amount is expended on direct labour, and 2s. on incidental and standing charges, which, however, are increased or reduced per unit of output relatively to the quantity produced; and if a colliery is only producing (say) 1000 tons a week when it has a capacity of 1500 tons, it is manifestly not working under favourable conditions. This has been the case with very many of the most important collieries in the country during the last six months. A large number of pits have been carried on at an absolute loss. As regards a great many more, the profits realized have not averaged 1d. per ton. Only comparatively few have had a tolerably satisfactory year. In view of the impossibility of continuing the present condition of affairs, many of the leading colliery-owners look forward to the future with a good deal of apprehension. Prices must either be improved or the wages of miners must be reduced. The former alternative is not entirely in the hands of the coalowners, unless by combination, while the latter is comparatively easy. A reduction of 10 per cent. in the average earnings of the colliery operatives of the country would yield an average difference to the trade of about 3½ millions sterling a year—assuming the present average daily rate of wages to be about 5s. and the average number of days worked throughout the country to be 250 in the twelve months. Even this resort would not compensate the owners for the serious difference that has taken place in the realized selling price of coal; but it would be likely to go a pretty long way in that direction.

Having regard to the suicidal conflicts that have taken place during the last few years in the coal industry of Great Britain, we can hardly regard with equanimity the prospect of similar struggles in the future. The adjustment of the rate of wages to be paid to miners is now determined in the North of England and in South Wales by a sliding-scale, which automatically fixes the relation of a certain realized price to a certain specified rate of wages. This system was introduced into the coal industry of Durham after the great strike of three years ago, and has since answered successfully. In the coal industry of South Wales, a sliding-scale agreement has been in operation for nearly twenty years; and, despite occasional strains which have threatened its continued existence, it still holds the field. But in the other leading districts, and especially in the great Yorkshire, Derbyshire, and Lancashire fields, there is no method, short of the uncertain and precarious one known as the "higgling of the market," for determining what wages shall be paid to the mining operatives; and experience has shown this method to be a failure. In a few weeks, the Midland coalowners will have to reconsider the arrangement made after the great strike of two years ago; and this necessity is already causing uneasiness and anxiety as to possible results. The workmen have again and again declared that they will not submit to any further reduction of their present rate of wages, which may average about 5s. 8d. to 6s. per day on a full week's work; while the coalowners have no difficulty in proving that, unless they can obtain better prices for their coal, they cannot longer afford to pay a rate of wages which is 30 per cent. above the rate paid in 1888, when the realized price of coal was not much different from the general average of the present time.

Under these circumstances, the attention of coalowners has again been directed to the question of how far it may be possible to bring into practical operation a combination designed to maintain and, if possible, increase the selling price of coal. Many different proposals have been made with that end in view; but not one has succeeded up to the present time. In the North of England a combination, known as "the limitation of the vend," was organized and carried on for a number of years towards the close of the last century; but the conditions of that time were in no way comparable with those of to-day, when the area affected and the output to be controlled are at least fifty times greater than then. Nevertheless, it is not to be overlooked that effective combinations have been carried out in other countries, and are, indeed, in actual operation at the present time. The coal trade of Westphalia has intermittently, for a number of years past, been controlled by a Syndicate of coalowners, who are pledged, under considerable penalties, not to produce more than a stipulated quantity, and not to sell below a specified price. The coke trade of Germany is "syndicated" in the same way. Several combinations of coalowners exist in other Continental countries; and it is well known that for a considerable period the great anthracite coal industry of Pennsylvania, which raises about 50 million tons a year, was subject to similar control.

In all these cases, however, there has been a notable identity in the conditions to be dealt with. Not so with the coal trade of Great Britain as a whole, which opposes one district to another and one branch of the coal industry to another at many different points, where each district and each branch of the trade has more or less different markets, and where uniform prices would be likely to mean large profits to one and no profits at all to another, according as the cost of production was higher or lower. Besides all this, it would probably be impossible to secure anything like uniformity in the rates of wages paid in different districts; and, unless the different coal-fields were assimilated as far as possible from this point of view, uniformity of selling price could hardly be looked for. A regulated selling price or schedule of prices would therefore be extremely difficult, but not necessarily impossible; and it would, at any rate, be worth a serious effort, in view of what appears to be the likely alternative of another conflict between the coalowners and their men. The contract made seventeen months ago, on the termination of the great Midland strike, has now come to an end; and though neither side has yet had the temerity to disturb the *status quo*, negotiations looking to that result must shortly be opened, should trade not rapidly improve. The coalowners, in the meantime, are exercising commendable forbearance, hoping that the expected further revival of business will so react upon the coal industry as to render it possible to postpone indefinitely a reduction of wages, to which the actual economic conditions would have entitled them long ago.

It may assist a better understanding of the issues involved in this matter if we give a comparative statement of the differences in the daily rates of wages paid to miners in various European countries. The following figures were presented by the representative of the Northumberland miners at the Berlin Mining Conference of 1894, as an *aperçu* of the average rates paid at that time, since which there have been reductions in this country that will probably average 10 per cent. all round: England, 6s. to 6s. 6d.; Germany, 3s. to 3s. 6d.; Belgium, 2s. 6d. to 2s. 8d.; France, 3s. 6d.; Austria, 2s. 8d. Two, at least, of these countries compete with our own in respect of a considerable share of our export trade; and it will not be forgotten that the United States, where coal is produced much more cheaply than in any Continental

country, sent a considerable quantity of coal to England last year in competition with the English product. Consequently, the margin of difference has now been narrowed down to what may be regarded as irreducible dimensions, if we are to retain our normal share of the world's coal business. Nor should we overlook the fact that New South Wales, Japan, and Nova Scotia are now competing against us in the markets of the East and West to a much larger extent than they have ever done before, and threaten to do so with increasing success in the time to come.

THE BIRMINGHAM WELSH WATER SCHEME.

The Remuneration of the Engineer Divulged.

For some time past, there has been an unquenchable longing on the part of several of the city councillors and ratepayers of Birmingham to learn the terms upon which the Engineer of the Welsh water scheme (Mr. James Mansergh) had undertaken the work; but until last week they were unsatisfied. At the outset, Mr. Mansergh suggested that the rate of his remuneration should be kept private; and this was agreed to by the late Sir Thomas Martineau on behalf of the Water Committee. The matter has been mentioned on many occasions in the Council, and has caused the Committee and their Chairman (Alderman Lawley Parker) a great amount of worry.

At the Council meeting last Tuesday, Mr. Marsh moved a resolution, directing the Committee to obtain Mr. Mansergh's acquiescence to the disclosure of the terms; but immediately afterwards he learnt that this had already been granted. The motion having been seconded, Alderman Lawley Parker announced that, thanks to Mr. Mansergh, he was in a position to give the information. He read a letter which he had received from Mr. Mansergh, who, thinking it unfair that the sufficiently onerous duties of the Committee should be increased by constant worry on this point, said he was now willing that the terms should be divulged. He explained that he wished for privacy because he had undertaken the work at a considerably lower rate than he had ever been paid by other clients, and that some trouble might arise if this became known. The reason he had accepted these terms was that the Birmingham undertaking was an unusually large one, and that the net relative remuneration after all outgoings, would probably work out pretty much as usual. He did not think it just that he should have to run the risk of this disclosure prejudicing his position elsewhere when, under the respective circumstances, fair agreements had been made in all cases. But, for the reason mentioned, he did not further object. After reading the letter, Alderman Parker pointed out that it was not at all unusual for engineers entering upon large undertakings with Corporations to ask that the terms should not be disclosed. This was so in the cases of Liverpool and Manchester—at all events, in the first place, and, so far as he knew, the terms had never been publicly stated. Two agreements were entered into with Mr. Mansergh—the first in October, 1892, and the second in October, 1894. They were identical in terms, but dealt with different portions of the scheme. Prior to October, 1892, the Committee reported to the Council that Mr. Mansergh would undertake, in accordance with the first agreement, the whole of the works in the watershed, the aqueducts, &c., as far as the Hagley syphon, and that Mr. Gray (the then Borough Water Engineer) would undertake the other portion, on the understanding that Mr. Mansergh should have that work to do also if Mr. Gray did not carry it out. Under the first agreement, the total amount to be paid to the Engineer for commission was not in any event to exceed the rate of 3½ per cent. on the estimate for the work, the net amount of which estimate, after making the necessary deductions for purchase of land, parliamentary, and other expenses, was to be taken at £2,417,693. The second agreement, referring to the work originally intended to be undertaken by Mr. Gray, was in exactly similar terms to the first, with a proviso that the maximum amount on which he was to be paid commission was to be fixed at £523,055 net. The main point of interest to the Council would be the rate of commission, and the limitation to which that commission was to be paid. So far as the Committee knew, the limitation was a new condition; and it meant that there was to be no commission on extras, although probably the extras would involve more trouble and anxiety to the Engineer than the other portion of the work. By putting the two amounts together, it would be seen that Mr. Mansergh would be entitled to 3½ per cent. on £2,940,748. The usual commission paid to engineers of the requisite standing on works of this character he found was 5 per cent., and, in addition, there was a sum paid for taking out quantities for contractors. The commission for the latter varied from 1 to 2½ per cent., according to the kind of work; and he thought they might take it that for large works it was generally 1 per cent. Then the client frequently paid the cost of printing and travelling, and the expenses of preparing plans in connection with the purchase of land. By the agreement, all these things were included in Mr. Mansergh's 3½ per cent. In addition to the engineering work, he took out all the quantities, prepared the plans (in this case, the latter would number something like 4000), and paid for printing and the travelling expenses. Mr. Mansergh also had to maintain, at his own cost, an establishment at Rhayader. The Council might like to know what difference there was between the sum at the ordinary rate and the sum Mr. Mansergh was to be paid on the whole contract. Assuming 5 per cent. for engineering work, and 1 per cent. for taking out quantities, it would work out at £176,443; and the 3½ per cent., at £102,925—or a saving of £73,518. It was due to Mr. Mansergh to point out that the 3½ per cent. covered very heavy expenses that he had to pay out of pocket. He employed a large staff entirely on the work; and many members of his staff were qualified engineers receiving very substantial incomes. He had to send out a small army of surveyors, who had to survey every yard of aqueduct in the watershed, and they were out for many weeks, at considerable expense. On the ability, knowledge, and judgment of their Engineer the expenditure of three millions and its results would depend. The Committee, in dealing with Mr. Mansergh, believed they had secured the first Engineer in this country, if not in the world, on favourable terms; and he (Mr. Parker) thought the terms would not have been so favourable had it not been believed by Mr. Mansergh that they would not be disclosed. He, therefore, felt the Council would appreciate Mr. Mansergh's willingness to allow the terms to be disclosed as they had been. Alderman Parker's concluding remarks were heartily applauded; and the speeches subsequently made by members showed that the terms were regarded with general satisfaction. Mr. Marsh withdrew his resolution, which, he assured the Council, had not been proposed in any offensive spirit.

THE INVESTIGATION OF PUBLIC WATER SUPPLIES.

By Floyd Davis.

[From the "Engineering Magazine."]

One of the most important factors in the prolongation of life and preservation of health in any community is a pure and wholesome water supply. The necessity of measures which enable municipal authorities to secure such water, in quantities to meet all demands, is now fully recognized by every intelligent citizen, who also knows that pure sources of supply can generally be determined only by a thorough and careful investigation. As the population of our country increases, the sources of contamination likewise multiply; so year after year it becomes more and more difficult to secure an adequate supply of water for cities and towns that shall be entirely free from dangerous impurity. In mountainous regions, where the conditions for self-purification are most favourable, we generally find the purest waters, in great abundance; yet in the Mississippi Valley, where the streams are generally sluggish and frequently heavily laden with organic impurity, and in the eastern States, where the rivers are sewage-polluted, the problem of securing pure water is difficult, and it is sometimes almost impossible with limited means to furnish a supply that is beyond dispute in its quality.

Many of our cities and towns lie adjacent to public watercourses, from which the water, polluted or otherwise, is pumped through mains, without proper purification, to be drunk by the people. Under such a disregard for sanitary considerations, it is not strange that in America we are still maintaining in some parts of the country a typhoid fever-rate higher than that prevailing in any other civilized country. Our typhoid death-rate is too frequently many times what it is in some European cities, like London and Berlin, which have expended millions of dollars to secure for their citizens a pure and wholesome supply of filtered water.

The ideal water for manufacturing and domestic purposes is distilled; and the amount of impurities, both inorganic and organic, found in natural water is, therefore, a measure of its purity. It is rare that the mineral constituents have any marked effect on the quality of a water for drinking, since the poisonous compounds of barium, iron, zinc, copper, lead, and arsenic, which may exist in it, are not often found in sources that are available for the supply of cities and towns; and in the sanitary investigation of a water supply, we do not usually look for these substances. But the mineral constituents have a bearing upon the use of a water for boiler and manufacturing purposes. Its suitability for the generation of steam is determined mainly by the amount of lime, magnesia, and mineral acids which it may contain, since these bases incrust the boiler and the acids corrode it. Magnesium chloride is especially objectionable. The mineral salts also characterize a water for manufacturing purposes, since a hard water containing much iron is unsuited for the manufacture of starch; a water having much magnesium in it is not desirable in the manufacture of beer; while water for distilleries should be as pure as possible.

These are considerations of importance only for particular purposes. But every public water supply must be used domestically by large numbers of people; and the substances which vitiate it for such purposes are of the greatest importance in its sanitary investigation. They are organic, both vegetable and animal, and exist in different proportions in all natural waters that have any communication with the surface of the soil. Decaying animal matter is indirectly far more dangerous than decaying vegetation; for it is from animal sources that the infectious bacteria, now considered the real agents of disease, are mainly derived. Upon the danger from these various impurities is based our classification of water supplies.

Whenever I am called upon to investigate the water supply of a city, which may include wells and other sources, I generally classify waters under five divisions, as follows:—

1.—Excellent waters, or those which are so pure and free from suspended matter that aëration and filtration would scarcely improve them. Aërated distilled water and the water from some springs in granite regions belong to this class; but it is rare that a chemist has to investigate them.

2.—Permissible waters, or those which can be used constantly for all domestic purposes, without any danger of injurious effects. They are waters which, however, can be improved by better methods of storage, or by a thorough filtration. Nearly all drinking waters belong to this class.

3.—Suspicious waters, or those which are liable at any time to produce ill-effects, or to be so polluted by an influx of filth that they may become bad, or even very dangerous. I always recommend that suspicious waters should be first thoroughly boiled, and then filtered, before being used for drinking.

4.—Bad waters, or those which are sufficiently polluted to render them unfit for domestic use. These may not be immediately productive of disease; but I believe that they lower the vitality of the system, and render it very susceptible of zymotic infection. On account of the nature of their pollution, common intelligence should prevent us from using them.

5.—Very dangerous waters, or those which are polluted by direct communication with cesspools or privies, and in which the pollution is of so high a degree that they should be immediately condemned. Such waters are often productive of typhoid fever and other filth-diseases.

In passing an opinion upon the quality of a public water supply, it is therefore essential that all water flowing into it which is seriously polluted with sewage should be rejected. There are other waters, not thus polluted, that have a disagreeable taste and odour, and are manifestly unfit for drinking; still, they are sometimes used in public supplies, largely from necessity. Cisterns and common surface wells are too infrequently used for public purposes to be considered here; and there are few or no apologies for such a supply in any wide-awake town, although, from a sanitary standpoint, they deserve our most careful consideration.

Springs are used as a source of public water supply in many mountainous regions where the topographical conditions are favourable for their utilization; but in other localities, ground waters, stored surface waters, rivers, and lakes are generally used. In many parts of Europe, several of these waters are introduced into one city, sometimes at great expense. In America, the usual source is the one that is most convenient to adopt, which is somewhat determined by the topographical conditions of the locality. Thus Denver has a delightful water supply furnished by mountain springs and melting snow, supplemented by hundreds of artesian wells. Some cities, like Columbus and Des Moines, located near never-failing streams, utilize the ground waters in the adjacent gravel beds. Boston and New York, having no adequate supply of fresh water near by, store in artificial lakes or reservoirs the rainfall on the nearest elevated watershed. Some cities, like Cincinnati, St. Louis, and Omaha, situated on rivers, secure their water supply from these natural channels; while others, like Cleveland and Chicago, having great lakes at their doors, reach out into these for their waters.

Spring water which flows from subterranean sources is generally pure and wholesome, because from necessity it is free from organic contamination; and, when the springs are remote from the agencies of pollution, their water is certainly our most healthful beverage. It is so much superior to surface water for domestic use that some cities have incurred great expense to introduce it for a public supply, and in some instances have thus freed themselves of much sickness and a high rate of mortality.

Ground water in regions remote from habitations is generally very pure; and although it may be, and frequently is, derived from polluted rivers, yet, owing to its thorough natural filtration, it cannot often be considered unwholesome. Indeed, with the exception of springs and some mountain streams, I consider ground water by far the best general supply for a city; and in the Mississippi Valley this can usually be easily obtained. When such water is secured from wells and filtering galleries in beds of gravel above a city, or along a river course some distance from its channel, it is mostly clear, sparkling, and nearly free from organic matter. This is especially true when the gravel beds are separated from the surface by an impervious stratum of clay, and the supply of water comes for long distances by filtration from rivers or other inexhaustible sources. Such water owes its purity to sedimentation and thorough filtration, combined with oxidation; for, during the passage of the water from its source to the well or gallery, the suspended decaying organic matter and the bacteria are retained in the soil, while the soluble organic substances are oxidized into harmless inorganic compounds. It is usually superior to artificially purified water, inasmuch as it is rendered pure long before being utilized, while surface water is purified as it is used.

Stored surface waters, rivers, and lakes may be very similar in their impurities. The former, when gathered on uninhabited watersheds, will contain little else that is harmful than decaying vegetable matter. But rivers are the receptacles of the waste products of the inhabitants of the districts through which they flow, and are sometimes very dangerous to use. When it becomes known that a surface water is in any considerable degree contaminated with the wastings of feed-lots and slaughter-houses, the refuse of manufactories, dead and decaying animals, and the drainage filth of many thousand square miles, it should be avoided; and, when it is further contaminated with sewage, or privy and cesspool drainage, or in any way mixed with the waste products of the human body, its use for drinking and cooking should be prohibited, for some of our most dreaded diseases are now traced to such water supplies.

My reason for rejecting all such water as unfit for human use depends also upon two other principles well established in all civilized communities. The first is that common decency causes every intelligent person to rebel against the use of sewage-polluted water. The second is that, when a water has once become infested with disease-germs, it can never be entirely purified, except by distillation or sanitary filtration. Such germs are liable to be contributed to these rivers at any time, should a sporadic case or an epidemic of typhoid fever occur in the drainage area above, and the dejections of the patients go into the river. The impurities in these river waters are such as will favour the multiplication and development of germ life; and the living organisms, instead of disappearing, sometimes become more numerous as the rivers are descended. During high water, when there can be no permanent sedimentation, these waters become constantly more impure in their flow down the river; so in using them as a source of supply, we must expect to be confronted with all the evil effects that can arise from the sewage and filth that go into them.

From whatever source a public water supply is derived, it should be borne in mind that it will not remain constant in purity throughout a whole season; for there are fluctuations depending upon rainfall, temperature, season, vegetable and animal contamination, and communication with other morbific agents. These variations and the probable degree of contamination of the public water supply should be investigated by the health officers, city physician, or other responsible and capable person, who should communicate his results to the people; and these investigations should extend to the surface wells and other sources of water, which the more ignorant and less fortunate classes are often compelled to use. It is a comparatively easy matter for one somewhat skilled in scientific manipulation to make a few qualitative tests that will enable him to determine, with considerable accuracy, whether or not a given water is badly polluted. For such examination, I usually recommend two tests, one for chlorine, and the other for decaying organic matter.

In most parts of the country away from the sea and salt wells, the purest ground and surface waters do not contain more chlorine than suffices to give, with a solution of silver nitrate, a faint opalescence. In testing water with this reagent, its action on a sample of known purity near by should be determined, to be used as a guide in comparing other waters. And whenever an experimental sample shows a decided milkiness with this reagent, then sewage contamination is to be suspected, in proportion to the amount of the precipitate.

Decaying organic matter is never found in appreciable quantity in pure water. If to a glassful of such water a few drops of sulphuric acid and a few drops of a dilute solution of potassium permanganate be added, a permanent pink colour is produced. But if the water contains decaying organic matter, then the pink colour becomes fainter, and finally disappears. In the hands of an expert, this is an important test; but it cannot be relied upon with a novice, since ferrous sulphate, hydrogen sulphide, and other reducing agents, sometimes present in water, produce similar results. But when a water shows an excess of chlorine, and bleaches potassium permanganate, it is certainly suspicious, and should be analyzed by an expert. My advice in all cases where persons seek counsel is to make the experiments given above, and, if the results are not satisfactory, to send the water to an experienced chemist, with necessary information regarding its source, and have a thorough analysis made.

The most extensive investigation of the quality of a water supply involves questions of a chemical, microscopical, biological, and physiological character, together with an examination of the surroundings of the source of supply. In all this, much depends upon the judgment and experience of the analyst, for water analysis is certainly among the most delicate of all chemical operations, and its proper interpretation requires great experience. The chemical analysis should determine the present and past pollution of water, and distinguish between vegetable and animal matter. The microscope should reveal floating substances, like fragments of hair, excreta, and other filth derived from surface drainage or sewage, which show at once that the water containing them is loathsome, and unfit for domestic use. The bacteriological investigation should be for the purpose of detecting infectious germs; but it is more frequently made to determine the number of microorganisms in a given volume of water. The physiological test should be made in order to afford opportunity for studying the effect of the water on the lower mammals. Since bacteria are now believed to be the direct or indirect agents of all zymotic diseases, the determination of the conditions favourable for their development, as shown by the chemist, or of their actual existence in water, as shown by the bacteriologist, is the real aim of sanitary water analysis.

Without discussing the relative importance of the chemical, microscopical, bacteriological, and physiological examinations, it is only necessary to say here that, whenever a chemical and microscopical analysis reveals an excess of filth or sewage in a water, its use should be discontinued without further investigation; for the time required for a thorough bacteriological analysis renders it too expensive for general use, to say nothing of the common failure to recognize the infectious germs. The most experienced water analysts look more to the chemical and microscopical results than to the bacteriological, because the chemical and microscopical methods of study are highly perfected, while the bacteriological methods are yet in a chaotic state so far as utility is concerned.

It is my opinion that the past history and associations of many waters are often sufficient to condemn them, no matter how free they may seem to be from organic impurity; and it is not always necessary to make a laboratory investigation to condemn some of the polluted ones. Then, too, every analyst knows, or should know, the importance of having a thorough knowledge of the surroundings of the source of supply, before giving an opinion as to the quality of a water for drinking; and I believe that no competent chemist will claim that a water high in chlorides and nitrates, although organically quite pure, is good, without a knowledge of the agencies which may pollute it. Inexperienced chemists are in error in sometimes relying wholly, in testing a water, upon the Wanklyn process, which determines the free and albuminoid ammonia, but affords no knowledge of its past history, or of the products of oxidation of its organic matter. Any analyst who finds a water contaminated beyond a reasonable limit of safety is justified in condemning it. But because he may fail to find any of the immediate products of decomposition of organic matter, he would not, in my judgment, be warranted in pronouncing such water good, unless he knew that such products had never existed in it; for it frequently happens that a water having direct communication through the soil with cesspools and privies has but little organic matter in it. In all such cases, the amount of chlorides and nitrates in the water is excessively high, and generally the total solids and loss on ignition are also large. Still, it is not different from what we often find in good mineral waters; and a chemist who relies solely on his laboratory determinations might claim that such water is good and safely potable, while in fact it may be a most dangerous beverage, and badly infested with disease germs. Thus it is that an opinion of the quality of a water should be given only after a careful consideration of the surroundings of the source of supply. More than this, I believe that no chemist should, and no experienced reputable chemist would, venture a decisive opinion as to the purity and wholesomeness of a water supply for a city or town without a personal inspection of the topography of the surrounding territory. It is unwise, if not impossible, to predicate an opinion upon the investigation and report of inexperienced men, or to determine the present and prospective soil-pollution without a personal inspection of the entire drainage area.

England formerly led the world in the investigation of public water supplies; but in recent years Massachusetts has given us classic results in this, as well as in the filtration of water. So in America we are just beginning to realize that pure water, which was once the luxury of the few, is now the necessity and pleasure of the many. The benefits which have resulted from these and other investigations are attested by the healthful development and increased civilization of our race; for it is now admitted by all competent judges that the progress made by the inhabitants of manufacturing towns, in decency, cleanliness, self-respect, and morality, since the introduction of a pure public water supply, is as striking as the improvement in their health, which shows that pure water is a great moral, as well as hygienic, agent.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Hamilton Corporation are still to be congratulated upon the prosperity of their gas undertaking. On Thursday night, Bailie M'Hale, who is the new Convener of the Works Committee, reported that they had three records in the production of gas during December. On the 14th, the make was 570,000 cubic feet; on the 21st, it was 603,000 cubic feet; and on the 28th, it was 703,000 cubic feet. The maximum output in any one day in December of 1894 was 550,000 cubic feet. The output of 703,000 cubic feet in one day is practically three times greater than the maximum in 1885. It was also about three times the total storage capacity at the works, the effect of which was seen in a slightly higher cost of the gas into the holder.

I learn that negotiations are in progress for the introduction of the Peebles oil-gas process into the Paisley Corporation Gas-Works. If these are satisfactorily concluded, I look upon the circumstance as the most important acquisition which the proprietors of the process have yet made, because Mr. G. R. Hislop, the Engineer and Manager at Paisley, is one of our most original thinkers in all matters practical; and he has been so successful in the distillation of coal, that it is next to a certainty that his working with oil will result in something which will be worth recording.

Many of your readers will learn with regret of the death of Mr. William Brodie, of the firm of William Brodie and Son, Gas Engineers, of Paisley. Mr. Brodie, who had reached the age of 60 years, served his time as an apprentice engineer with the firm of Reid and Hanna, of Paisley; and afterwards he started in business as a gas engineer in Paisley with Mr. Cowden, as the firm of Cowden and Brodie. Their work was at first on a small scale; and was conducted in a shop in the "Wee House" Close. But after about fifteen years, it had greatly increased; and then, on the death of his former master Mr. Reid, he secured the business carried on by him, and removed to South Croft, where he has carried on his work since, in conjunction with his son. Mr. Brodie was widely known in gas circles, and was greatly esteemed for his business qualities. He was an exceedingly pleasant social companion; and his company was much sought after on account of his never-failing fund of wit and humour. He died of paralysis. A widow, one son, and two daughters survive him. It is understood that the business is to be sold as a going concern.

The Corporation electric lighting installation in Ayr was inaugurated on Wednesday night; the current being turned on by Mrs. Willock, the wife of the Provost of the town. Lord Kelvin, who had been brought down to start off the venture with his blessing, adopted the sensible course of speaking of the application of electricity to lighting and other purposes as a dream of science. He might have gone further, however, and said "of speculative scientists." It was abundantly clear from the remarks of Provost Willock that in Ayr at least the Corporation would have been quite content to have allowed the scientists to go on dreaming; for he stated quite frankly that it was the intimations of two companies that they were about to apply for Provisional Orders to enable them to light Ayr, which brought the Corporation to book. Even on the evening of the turning on of the light, there was a disappointment. The people had flocked to the principal streets in large numbers to see the new illuminant—in great expectations, no doubt; but only about half of the lamps were lighted, and, of course, the remarks made were not all complimentary.

The subject of the electric lighting of the tramway cars in the city was discussed by the Glasgow Town Council on Thursday. Mr. Walter Paton, the Convener of the Tramway Committee, said that the Froggatt Electric Lighting Company, which was now in liquidation, undertook a work which it was now quite apparent they were not able to do. The contract all through had been very unsatisfactory; and the Committee were now obliged to discard the electric light. They must wait till they saw what would be the Company's position, before they could decide what was best to be done. A Sub-Committee had, however, been appointed to deal with the subject of the lighting of the cars; and they would consider not only the electric light, but also gas lighting. The Corporation ought to experiment with gas in some of their cars, and satisfy themselves as to which would really be the more suitable light.

The trial took place on Wednesday, in the Sheriff Court at Dumbarton, of Philip M'Dermott, on a charge of culpable homicide, in connection with the fatal accident in the Dawsholm gas-works of the Glasgow Corporation on Oct. 11 last. M'Dermott was in charge of a travelling steam crane, which was so situated that, when the jib of it was swung round, it only left a space of 2½ inches between it and a hopper which was being constructed. The position was so manifestly dangerous, that instructions were given that the crane was not to be moved without orders from the foreman. Notwithstanding this instruction, M'Dermott swung round the crane, and crushed an apprentice boiler-maker who was working at the hopper, killing him on the spot. After the accident, M'Dermott became insane; but he had since recovered sufficiently to be able to plead. He denied the charge; but was convicted on evidence. The jury, however, strongly recommended leniency; and the Sheriff, taking into account that he had already been two months in gaol, sent him to prison for other twenty days.

There was a foolish explosion of gas in the County Buildings in Paisley last Saturday afternoon. I say "foolish," because it was caused by the caretaker of the place searching for an escape of gas with a lighted taper; and a man who is in such a position as his, ought to know better than to do such a thing. The caretaker was pretty severely burned, and was also cut by falling glass. A police sergeant was also slightly injured by broken glass. The escape of gas was due to a faulty gaselier in a witness-room.

The persistent preaching up of the Edinburgh electric lighting installation, has brought about that which might have been expected—a crop of motions for extension. The notion has, not unnaturally, got abroad, that if there is to be such a large surplus in the first year, it should be applied to the extension of public lighting. There are proposals before the Corporation for the extension of the street lighting to so many places that the Council, at their meeting this week, were evidently put out of countenance. Besides the fresh proposals, there was a recommendation by the Electric Lighting Committee to make large extensions. The Council got frightened at the cost, and sent their recommendation back to the Committee, along with the fresh proposals, for further consideration.

In Linlithgow, certain of the town councillors have been casting hungry looks towards the Gas Company; and notice was given of a proposal to remit to a committee to consider the expediency of the Corporation adopting the Burghs Gas Supply Act, with a view to their acquiring the Company's undertaking. On Tuesday night, however, at a meeting of the Council, the notice of the motion was withdrawn; the principal reason being that the proposer is, through circumstances which have developed suddenly, about to leave the town, and he did not care to be the mover in a matter which might bring a burden on the town which he would not be there to share. The other members did not seem to be very enthusiastic on the subject, as they allowed the matter to drop. The necessity for new works was talked about; and some of the members spoke about the need there would be for imposing a rate—from which I infer either that the existing works are not very good, or that the town councillors know very little about them, or about the subject.

I observe from a return that the price of Dundee Corporation gas annuities, per £10, has risen since 1890 from £298 to £355.

The President of the Board of Trade has appointed Mr. A. Vernon Harcourt to conduct an inquiry into the circumstances attending the explosion in the Forfar Gas-Works, by which the Manager (Mr. Forbes Waddell), and a stoker were injured. The end of next week is the time suggested for the inquiry.

The Gas Commissioners of North Berwick are in the fortunate position of being able to report an increased consumption of gas by 49,000 cubic feet in one week at the end of the year, over that in the corresponding week of the preceding year. The quantity is small; but it is quite satisfactory when the size of the place is considered.

Dr. J. S. Haldane, Lecturer on Physiology in Oxford Univerity, gave a very interesting lecture to the members of the Scottish Natural History Society in Edinburgh last night, on "Abnormal and Vitiated Atmospheres and their Action on Man." He first noted the effect of vitiated atmospheres upon flames. When, he said, the oxygen percentage in the air fell from the normal (about 20·9) to about 17·3, matches, lamps, and candles were always extinguished. Whereas it was often said that 3 per cent. of carbonic acid would put out flame, and it was actually recommended as an active agent in extinguishing fires, he had found a flame burn brightly in an atmosphere composed of 30 per cent. of oxygen and 70 per cent. of carbonic acid. Going on to record the results of his experiments upon the human subject—which, it appeared, was often himself—by the diminution of the oxygen in the air breathed, he found that when the oxygen fell to 13 per cent., there was no real discomfort except damp; that when the percentage fell to 8, the face began to assume a leaden colour; and that when it decreased to 5 or 6, there was marked panting, accompanied by failure of the senses and of power over the limbs. The breathing of atmosphere free from oxygen, or containing only a small percentage, caused the subject to be unconscious and fall over within about forty seconds, and without any perceptible previous distress. In these experiments, the carbonic acid expired by the subject was absorbed chemically. As to the effects of carbonic acid upon the human subject, he found that when this gas was increased to 3 or 4 per cent., the respirations were deeper and more frequent; that as the experiment went on, the panting became greater and greater; and that when the percentage had gone up to 5 or 6, the person was simply panting as hard and as deeply as he could, just as if he had been running or engaging in some other form of exertion. With 10 per cent. of carbonic acid in the air breathed, the panting became so distressing and intolerable that it was not possible to continue the experiment. Carbonic acid in large percentages was thus a poisonous gas; though when the percentage was less than 3, it seemed to be quite harmless. Coming to the investigation of the effects of vitiated air in dwelling-houses, schools, and public buildings, Dr. Haldane stated that in ordinary cases the percentage of carbonic acid was never so high as to be capable, by itself, of producing dangerous effects. The air must contain about 3 per cent. of carbonic acid before any abnormal effects presented themselves; whereas not more than one-tenth of this quantity was contained in a crowded room. The same general remark applied to the slight diminution which occurred in the oxygen. Dr. Haldane next spoke of the presence of deleterious and dangerous gases in mines. Concerning fire-damp, he said it was quite common to find that for every ton of coal raised, about 10,000 cubic feet of gas were given off in the pit; and that amount, when mixed with eight or ten times its volume of air, would produce about 100,000 cubic feet of an explosive mixture. Discussing the effects of carbonic oxide, he pointed out that its symptoms were identical with those produced by atmospheres poor in oxygen. Coal gas contained from 5 to 10 per cent. of carbonic oxide; so that 1 per cent. of coal gas in the air would produce the headache, nausea, and other preliminary symptoms of carbonic oxide poisoning. Finally, noting the effects of sulphuretted hydrogen, Dr. Haldane stated that, whereas it was said that 3 per cent. of this gas might be breathed without danger, his experiments led him to the conclusion that this percentage would cause almost instant death. Dr. Macmillan, in proposing a vote of thanks to Dr. Haldane, said the lecture had thoroughly revolutionized many accepted theories.

Following up this subject, it is appropriate to mention that on Thursday of this week a number of workmen who were excavating in Bilsland Drive, at Gairbraid Street, Glasgow, unearthed an old gas-pipe, from which gas escaped freely. A man from the Corporation Gas Office was called in; and he set about repairing the pipe while the workmen went to their dinner. When they returned, they found the man lying unconscious, with his face against the pipe. The poor man had, it is thought, been overcome by the gas. He died shortly after being discovered.

Forthcoming Sale of Suburban Gas Shares.—Mr. Alfred Richards has been commissioned by the Directors of the Chigwell, Loughton, and Woodford Gas Company to sell 200 £10 shares, ranking for a dividend of 7 per cent.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan.* 11.

Sulphate of Ammonia.—The market has been fairly steady; but prices have barely been maintained. There has been a fair demand; and parcels placed on the market have moved off. But for delivery over the spring months, a very small premium is required; and this fact, together with larger production, has no doubt prevented any improvement in spot values. The quotations f.o.b. at the ports are £8 10s. to £8 11s. 3d. per ton.

Nitrate of Soda remains quiet at 7s. 7½d. to 7s. 9d. per cwt. on spot. Cargoes afloat have changed hands at a decline during the week. But at the close, the tone is again firmer; and the value of cargoes due is about 7s. 5½d. per cwt.

LONDON, *Jan.* 10.

Tar Products.—Without any important new business being noted, the market for most tar products continues fairly steady. Carbolic acid is still in favour, and it appears there is very little stock in makers' hands. If it proves that this considerably increased demand for carbolic acid is for picric and explosive purposes, its value may very shortly be considerably augmented. Benzol, so far, maintains its improved value; but buyers are somewhat shy of contracting far forward, at the rates now quoted. Solvent naphtha is moving off more freely; and anthracene is quiet at Committee's rates.

Market prices obtaining during the week, less the usual discount, are: Tar, 18s. to 24s. Pitch, nominal, 33s., west coast; 36s., east coast. Benzols, nominal, 90's, 2s. 3d.; 50's, 2s. Solvent naphtha, 1s. 4d., for shipment; 1s. 6d. for home consumption. Toluol, 1s. 10d. Crude, 30 per cent., naphtha, 10d. Creosote, 1¼d. Naphthalene, pressed, 45s.; drained, 27s. 6d. Cresylic acid, 1s.; crude, 10d. Carbolic acid, 60's, 1s. 8½d.; 75's, 2s. 1d. Anthracene, "A," 11d. to 1s.; "B," 9d. to 10d.

Sulphate of Ammonia is more inquired after. Considerable lots have changed hands; and there is a better disposition for forward business. Buyers, however, will not pay the prices asked by makers for spring delivery. There is no change in values; and prices are exactly the same as quoted last week—viz.: Beckton terms, £9; London, £8 12s. 6d.; Hull, £8 11s. 3d.; Tyne, £8 12s. 6d.; Leith, £8 10s.; Liverpool, £8 12s. 6d.—all, except Beckton, less 3½ per cent. f.o.b. Gas liquor is offered at 6s. to 7s. per ton for 10-oz. quality.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Except for a slightly increased demand just after the pits got back to work, there is no appreciable improvement to notice in the coal trade of this district, either as regards the weight of business doing or the prices obtainable; and although the pits were in most cases stopped over a longer period than usual for the holidays, there has been no appreciable accumulation of orders to work off since they re-commenced operations. For house-fire qualities, the demand continues only small; and the output of the collieries, working five days per week, is ample for present requirements, with the result that prices are not more than maintained at late rates. The lower qualities of round coal, suitable for iron-making, steam, and general manufacturing purposes, still hang upon the market owing to the excess of supplies; and the eagerness to secure orders gives a weak tone to prices, in which a good deal of irregularity prevails. With the present limited output of slack, engine fuel moves off readily. The demand is generally quite equal to the supplies offering; and a firm tone is maintained as regards rates. The average pit mouth prices remain at about 10s. to 10s. 6d. per ton for best Wigan Arley; 9s. to 9s. 6d., for seconds Arley and Pemberton four-feet; 7s. to 7s. 6d., for common house coal; 6s. to 6s. 6d., for ordinary steam and forge coals for inland sales, with 5s. 6d. taken where anything like quantities could be moved away for shipment; 3s. to 3s. 6d., for common slack; and 4s. 6d. to 5s., for best sorts. Extreme quietude continues the general report in the shipping trade, with prices ruling as low as ever; ordinary steam coal being obtainable at about 7s. to 7s. 6d. per ton, delivered at the ports on the Mersey.

Northern Coal Trade.—There is now a return to normal conditions in the coal trade of the North; but the work at the steam coal collieries is far from full. The reduction of 1¼ per cent. in the rate of wages, as the result of the lower average price of coal, is an indication that not only the volume but the value of the trade is lower than it has been. Best Northumbrian steam coals are still quoted at 8s. per ton f.o.b.; second kinds, at 7s. 6d.; and steam smalls, at from 3s. 6d. to 3s. 9d. To an extent, these prices are nominal, as it is believed that some of the collieries will make concessions to enable the pits to work a little fuller time. There is no alteration in the manufacturing coal trade; but larger quantities are being taken on contract, now that the works are again in full swing. The demand for gas coal is still extremely large; and some of the collieries are practically out of the market for two months or so—contract quantities taking up the output. For single cargoes, the general quotation is still 6s. 6d. to 7s. per ton f.o.b. for best Durham gas coals; while other kinds may perhaps be quoted at about 3d. less. For distant parts, there is the advantage of a very low average freight on coals just now. In regard to coke, a full demand continues to prevail, especially for the local iron-works. For shipment, the demand is a rather limited one; and the general price is about 14s. 6d. per ton f.o.b. In gas coke, there is this week no alteration of price, and the full quantities that are now being taken by manufacturers will prevent the accumulation of stocks.

Scotch Coal Trade.—The coal trade in Scotland has scarcely yet recovered itself after the holiday season, which this year has been rather more prolonged than usual, on account of the slackness of business. There is little demand for any class of coal, except for the better sorts of ell, for which there is a fair market. The smaller varieties of nuts and dross are in good demand, as they have been generally since the introduction of mechanical stokers to steam-boilers, for which small fuel is most suitable. The prices quoted are: Main, 5s. 10d. per ton f.o.b. Glasgow; ell, 6s. 9d.; splint, 6s. 6d. to 6s. 9d.; and steam, 7s. 6d. The shipments for the week amounted to 95,490 tons, a decrease upon the quantity in the preceding week of 49,842 tons, but an increase upon the corresponding week of last year of 25,503 tons, and upon 1894 of 3150 tons.

Annual Dinner of the Gas-Works Employees of the Selby District Council.—The third annual dinner of the employees in the Gas Department of the Selby District Council took place a few days ago, under the presidency of Mr. Scott. In the course of the proceedings, the work of the Manager (Mr. M. Dunn) was referred to in eulogistic terms; and he bore willing testimony to the assistance given to him by the staff and workmen.

The Lighting of Falmouth Streets.—The question of the general adoption of incandescent burners in the street-lamps was again under the consideration of the Falmouth Town Council at their last meeting. The Lighting Committee had received a letter from the Gas Company stating that, unless some definite arrangement was made before the end of the month, the incandescent burners fixed by the Company last year in Market Street would be removed without further notice. The Committee were of opinion that incandescent burners should not be adopted in the lamps throughout the town until they had been tried in some exposed situation; and, being of opinion that it was undesirable that there should be a partial use of the burners, they recommended that the Company be asked to replace the burners belonging to the Corporation at their convenience.

Bolton Gas Supply.—At a meeting of the Gas Committee of the Bolton Town Council last Friday, the following alterations and extensions were ordered to be made during the summer, and tenders obtained for the work: Alterations to purifiers at the Lum Street works; completion of the railway siding at the same place; erection of two new exhausters at the Gas Street works; also three hoppers. A Sub-Committee was appointed to further consider and report as to adopting mechanical stokers. Owing to the extension of the prepayment meter system, a special inspector was appointed whose duty it will be to see to these meters. It was reported to the meeting that there was a phenomenal consumption of gas on the 24th of December; it being 97,000 cubic feet in excess of any day previously recorded. The make of gas in December showed a considerable increase; the total production being 7,878,000 cubic feet. Only four additional retorts were in operation, and 536 more tons of coal carbonized. The working of the new carbonizing plant has, it is claimed, brought about this satisfactory result.

New Water-Works at St. Austell.—Rapid progress is being made with the construction of the new works for supplementing the water supply of St. Austell; and it is anticipated that the new reservoir will be completed by February. The estimated cost of the scheme, which was designed by Mr. J. Sambles, the Surveyor to the District Council, is £5200. Seven distinct springs, distant about three miles from the town, yielding water of excellent quality, and covering a large area, contribute a supply of 200 gallons per minute, equal to about 62 gallons per head per day. One of the springs became polluted by the drainage from an old clay-works; and to remove this source of contamination, a pit has been filled with thousands of tons of sand, which has proved an excellent preventive. A 7-inch cast-iron main has been laid from the source to the reservoir which is in course of construction at Trenance, a distance of 1850 yards. The reservoir will hold 800,000 gallons of water; and the filter-beds have a capacity of 200,000 gallons; so that in all there is provision for a storage of 1,000,000 gallons. The reservoir is of concrete; and it will be covered, and strengthened with arches. It is situated at such an altitude that it will send water to a height of 30 feet above the highest point in St. Austell. From this new reservoir, a main has been laid to the old one at a level of 120 feet below, and, by means of a bye-pass at Trenance, arrangements were made last summer for supplementing the old supply by water from the new source—a boon which was much appreciated.

Underground Water in Australia.—The north-western portion of New South Wales, forming part of the great central Australian region, where the population is thinnest and most widely scattered, has always (a correspondent writes to the "Globe") been regarded as a country not fit for other than pastoral settlement, by reason of its dry and arid character. Yet it has long been known that underneath the greater portion of this uninviting region—at some remote period the bed of a vast inland sea—there existed cretaceous, or chalk, formations, from which ample supplies of water might be obtained by boring; but, despite such knowledge, it was not until 1879 that anything was attempted in this direction. Since then much work has been done; and in December, 1894, there were in the colony 30 bores completed, 9 in progress, and sites selected for 23 others. Of those finished, 20 yield a daily supply from artesian sources of somewhat over 7 million gallons. Ten bores tap a sub-artesian supply; and by pumping they furnish a daily yield of 500,000 gallons. In June, 1895, there had been completed by private enterprise 90 bores. Of these, 73 gave a combined daily flow which may be approximately stated at 30 million gallons; and from the other 17, a supply was being pumped. There were also one of which no particulars could be obtained, two in progress, and two which had been abandoned. Fifteen of the Government bores are used for supplying water on the north-western travelling stock routes; the approximate daily yield being somewhere about 6 million gallons. At present the water obtained from bores in the colony is not largely used for irrigation purposes; but when the boundaries of the area of supply have been definitely ascertained, it will prove an important factor in the national irrigation system. The whole of the cretaceous country, many thousands of square miles in extent, may be likened to an immense sponge, absorbing the whole of the drainage from the western sides of the tablelands; the surplus waters finding their way by channels, at present undiscovered, to the sea. Should these subterranean outlets ever become known, they will aid largely in increasing the Australian water supply, and in transforming now poor regions into rich pastoral and agricultural country; thus further enlarging the area of industrial settlement.

Mechanically Driven Vehicles.—The Birmingham City Council last Tuesday passed a resolution instructing that a memorial to the Board of Trade should be prepared, and signed by the Mayor, praying that a Bill might be brought in to relax the restrictions which now hamper the transit of all mechanically propelled vehicles along the public roads.

Incandescent Street Lighting.—The Rye Town Council have informed the Rye Gas Company that they are greatly pleased with the incandescent gas-lights which the Company have fixed, and they have given orders for the erection of additional lamps of the same kind. The Crays Gas Company have put up a number of incandescent lamps in the Cray Valley district, and the new departure in public lighting is being much eulogized in the local press. High Street and part of Westgate, Rotherham, have been fitted up with incandescent gas-burners in the street-lamps.

The Poll on the Water-Works Purchase Question at Eastbourne.—The result of the poll of the owners and ratepayers of Eastbourne upon the proposed purchase of the water-works by the Corporation, and the promotion of a Bill in Parliament for giving them powers to carry out the purchase and to construct new works, was declared last Wednesday, and was unfavourable to the scheme. The total number of papers distributed was 5167, and the voting was upon the cumulative principle; the maximum number of votes which any one person could record being twelve—six as owner and six as ratepayer. The papers returned numbered 4297. Of these 563 were blank, and 107 were improperly filled up. This left 3627 good, or about 70 per cent. of the total issued. The voting was as follows: In favour of the Corporation's proposals, 3527; against, 3752—majority against 225. Of the 3627 persons who voted, there was a majority of 219 in favour of the Corporation.

The Lighting Problem at Burnham-on-Crouch.—In the last number of the "JOURNAL," reference was made to the strange predicament in which the local authorities found themselves placed in connection with the public lighting of Burnham in Essex; it being the opinion of Mr. A. MacMorran that the Lighting and Watch Act, under which the place has been lighted for about five years, is not properly in operation, in consequence of certain formalities not having been complied with. As a result of this opinion, it has been deemed necessary to have a poll on the question of adopting the Act for the whole of the parish, and not for a defined area as hitherto. Only about half of the electors took the trouble to vote; and it being laid down in "Shaw's Parish Law" that "the total number of persons voting shall be a clear majority of the ratepayers of the parish," the Returning Officer at first decided to consult the Local Government Board before making a formal declaration of the poll. Afterwards, however, he took upon himself to veto the poll, as a clear majority of the ratepayers did not give their votes. The public gas-lamps are still lighted; but the question of who is to pay for the gas consumed remains unsettled.

Ossett Gas-Works Purchase Question.—By nine votes to four, the Ossett Town Council last Wednesday resolved to promote, either alone or in conjunction with the Horbury District Council, a Bill in Parliament for the purchase, compulsorily or otherwise, of the undertaking of the Ossett Gas Company.

Proposed Purchase of the Adlington Gas-Works by the District Council.—At a meeting of the Adlington (Lancashire) District Council last Wednesday, a discussion took place as to a proposed purchase of the local gas-works. Mr. E. Hargraves, who is a shareholder in the Gas Company, pointed out that one-half of the shareholders resided outside Adlington; and he contended that the profits derived from the undertaking should be devoted to the benefit of the entire township. Several members spoke in support of the purchase; and it was suggested that the Council should send a deputation to interview the Directors of the Company on the matter.

The Cost of Opposing a Water Company's Bill.—Many of the ratepayers of Whitby have doubtless been somewhat astonished to learn that the expenses incurred by the District Council in opposing the Water Company's Bill last year have reached the considerable sum of £1295. Attention was called to this by Mr. W. Langbourne at the meeting of the Council on Wednesday last. He declared that the ratepayers had not reaped any benefit from the opposition; and he hoped it would be a warning to them not to be led astray again. The Chairman (Mr. H. Walker), however, defended the opposition, and said the boon of a constant supply was well worth the money.

Fire at Messrs. Tangyes' Works.—A serious conflagration occurred at the Cornwall Works of Tangyes Limited shortly after noon last Saturday week. Owing to the immediate surroundings of the seat of the fire, the greatest anxiety and excitement prevailed; and although the cause of the outbreak is at present rather uncertain, a feasible explanation of its origin is given. In the grounds is a fitting-shop measuring 50 feet in length and 25 feet in width. This building, which stood before the fire on a lower level than the general stores, was quite open inside, although of two storeys in height, and was stocked with valuable machinery in use, and with portions of machines in course of construction. Between the fitting shop and the stock room, is a small space of ground, on which had been placed about 30 barrels of Russian oil. At the time mentioned, one of the workmen discovered that the barrels were on fire, and that the blazing contents were floating from the higher level to the fitting shop and other minor buildings adjoining. The works' fire brigade and the brigades of the district were immediately summoned. But by the time the latter arrived, the fire, fed by the contents of the bursting oil-barrels, had assumed extensive proportions; and the fitting-shop was completely burnt out. It is supposed that a spark from one of the chimneys ignited oil which had probably leaked from a barrel; but no definite cause of the outbreak can be given. The loss is fully covered by insurance. Practically no delay will take place in fulfilling the many large and important orders with which the firm have been entrusted.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 67).

Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	16 Oct.	10½	Alliance & Dublin 10 p. c.	22—23	..	4 11 4
100,000	10	,,	7½	Do. 7 p. c.	16½—17½	..	4 5 8
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	105—107*	..	4 13 5
200,000	10	16 Oct.	4	Belgrano (B. Ayres), Limited	7—8	..	5 0 0
100,000	Stck.	30 Dec.	5	Do. 5 p. c. Deb. Stk	90—95*	..	5 5 3
200,000	5	14 Nov.	6½	Bombay, Limited	6¾—7¼	..	4 9 8
40,000	5	,,	6½	Do. New, £4 paid	5—5½	..	4 14 7
380,000	Stck.	14 Aug.	12	Brentford Consolidated	273—278	+3	4 6 4
210,000	,,	,,	9	Do. New	210—215	..	4 3 9
50,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
159,375	,,	16 Dec.	4	Do. 4 p. c. Deb. Stock.	123—127	..	3 3 0
220,000	Stck.	27 Sept.	11	Brighton & Hove Original	227—232	..	4 14 10
208,820	,,	,,	8	Do. A Ord. Stk.	183—188	..	4 5 1
933,500	Stck.	29 Aug.	5	Bristol, 5 p.c. max.	124—128	..	3 18 1
420,000	20	27 Sept.	11½	British	54½—55½	..	4 1 1
50,000	10	29 Aug.	11½	Bromley, Ordinary 10 p. c.	22½—23½	..	4 17 10
67,010	10	,,	8½	Do. 7 p. c.	19—20	..	4 5 0
500,000	10	14 Nov.	4	Buenos Ayres (New) Limited	7⅞—8	−¼	5 0 0
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100—102*	..	5 17 8
150,000	20	11 July	8½	Cagliari, Limited	30—32	..	5 3 3
100,000	10	27 Sept.	6	Cape Town & District, Ltd.	12½—13	..	4 12 4
50,000	50	2 Nov.	6	Do. 6 p. c. 1st Mort.	56—58	..	5 3 6
550,000	Stck.	16 Oct.	13½	Commercial Old Stock	325—330	+2	4 1 10
165,000	,,	,,	10½	Do. New do.	251—255	..	4 2 4
165,000	,,	16 Dec.	4½	Do. 4½ p. c. Deb. do.	147—152	..	2 19 2
800,000	Stck.	16 Dec.	13	Continental Union, Limited.	263—268	..	4 17 0
200,000	,,	,,	10	Do. 7 p. c. Pref.	210—215	..	4 13 0
51,620	Stck.	29 Aug.	14	Croydon Com'cial A 10 p. c.	280—285	..	4 18 3
157,500	,,	,,	11	Do. B 7 p. c.	222—227	..	4 16 11
535,000	Stck.	29 Aug.	5½	Crystal Palace Ord. 5 p. c. Stk	127—132	..	3 19 6
60,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	26 July	11	European, Limited	25½—26½	..	4 3 0
354,060	10	,,	11	Do. £7 10s. paid	17—18	..	4 14 3
5,646,590	Stck.	14 Aug.	12¾	Gaslight & Coke, A, Ordinary	295—300	..	4 5 0
100,000	,,	,,	4	Do. B, 4 p. c. max.	107—112	..	3 11 5
665,000	,,	,,	10	Do. C, D, & E, 10 p. c. Pf.	287—292	..	3 8 6
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	135—140	..	3 11 5
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	200—205	..	3 13 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	193—198	..	3 10 9
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	287—292	..	3 8 6
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	170—174	+1	3 9 0
1,061,150	,,	16 Dec.	4	Do. 4 p. c. Deb. Stk.	137—140	+1	2 17 2
294,850	,,	,,	4½	Do. 4½ p. c. do.	145—150	..	3 0 0
908,000	,,	,,	6	Do. 6 p. c. do.	200—205	..	2 18 6
70,000	10	30 Oct.	6	Hongkong & China, Limited	13—14	−½	4 5 8
3,800,000	Stck.	14 Nov.	12	Imperial Continental	232—236	..	5 1 8
376,400	100	1 Aug.	4	Do. 4 p. c. Debs. Red.	100—103	..	3 17 8
473,600	Stck.	14 Aug.	3½	Do. 3½ p. c. Deb. Stk	107—109	..	3 4 2
75,000	5	16 Dec.	6	Malta & Mediterranean, Ltd.	6—6½	..	4 12 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	113—116	..	4 6 2
250,000	100	,,	4½	Do. 4½ p. c. Debs.	107—109	..	4 2 7
541,920	20	14 Nov.	5	Monte Video, Limited	16—17	−½	5 17 8
150,000	5	28 Nov.	8	Oriental, Limited	7¾—8¼	..	4 16 11
135,000	5	,,	8	Do. New, £4 10s. paid	6½—6¾	..	5 6 8
15,000	5	,,	8	Do. do. 1879, £1 paid	1¼—1½	..	4 11 5
60,000	5	12 Sept.	7	Ottoman, Limited	5—5½	..	6 7 3
166,870	10	14 Feb.	2	Para, Limited	1½—1¾	..	11 8 6
420,000	100	2 Nov.	6	People's Gas 1st Mtg. Bds.	105—110	..	5 9 1
500,000	100	9 Dec.	6	of Chicago 2nd Do.	100—105	..	5 14 3
250,000	10	16 Oct.	7	San Paulo, Limited	11—12	..	5 16 8
500,000	Stck.	29 Aug.	15½	South Metropolitan, A Stock	377—382	..	4 1 2
1,350,000	,,	,,	12	Do. B do.	308—313	..	3 16 8
308,685	,,	,,	13	Do. C do.	325—330	..	3 18 9
310,000	,,	11 July	5	Do. 5 p. c. Deb. Stk.	175—178	..	2 16 2
60,000	Stck.	12 Sept.	11½	Tottenham & Edmonton, A	250—255	..	4 10 2
60,000	,,	,,	8½	Do. B	—	..	—
170,380	10	30 Dec.	10	Tuscan, Limited	13—14*	..	7 2 10
149,900	10	2 Jan.	5	Do. 5 p. c. Debs. Red.	100—102*	..	4 18 0

WATER COMPANIES.

746,021	Stck.	30 Dec.	10½	Chelsea, Ordinary	292—297*	..	3 9 0
150,000	,,	,,	5	Do. 5 p. c. Pref.	165—170*	..	2 18 10
160,000	,,	,,	4½	Do. 4½ p. c. Pref. Stk., 1875	—	..	—
175,785	,,	27 Sept.	4½	Do. 4½ p. c. Deb. Stock	153—158	..	2 17 0
1,719,514	Stck.	16 Oct.	7	East London, Ordinary	215—220	..	3 3 7
654,740	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	155—158*	..	2 17 0
100,000	,,	,,	3	Do. 3 p. c. Deb. Stk.	104—106*	..	2 16 7
700,000	50	16 Dec.	6½	Grand Junction, 10 p.c. max.	114—118	..	2 15 0
280,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	140—145	..	2 15 2
708,000	Stck.	29 Aug.	12	Kent	310—315	..	3 16 2
160,000	,,	,,	7	Do. New, 7 p. c. max.	200—205	..	3 8 3
1,043,800	100	30 Dec.	7½	Lambeth, 10 p. c. max.	245—250*	..	2 18 3
406,200	100	,,	7½	Do. 7½ p. c. max.	207—212*	..	3 8 5
330,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	143—148	..	2 14 2
500,000	100	14 Aug.	12⅝	New River, New Shares	385—390	..	3 3 7
1,000,000	Stck.	26 July	4	Do. 4 p. c. Deb. Stk.	143—148	..	2 14 2
902,300	Stck.	16 Dec.	6	S'thwk & V'xhall, Ordinary	150—155	..	3 17 5
126,500	100	,,	6	Do. Do. 7½ p. c. do.	139—142	..	4 4 6
489,200	Stck.	,,	5	Do. Do. 5 p. c. Pref.	165—170	..	2 18 10
1,019,585	,,	—	4	Do. 4 p. c. A Deb. Stk.	144—147	..	2 14 6
1,155,066	Stck.	16 Dec.	10	West Middlesex	288—293	..	3 8 3
200,000	,,	,,	4½	Do. 4½ p. c. Deb. Stk.	155—160	..	2 16 3

*Ex div.

Additional Filter-Beds for Liverpool.—On the recommendation of their Water Committee, the Liverpool City Council have accepted a tender of Mr. E. Gabbutt, of Liverpool, for the construction of two filter-beds, on land adjoining the existing beds of the Corporation at Llanforda, near Oswestry, for the sum of £14,167.

Beneficial Results of the Prepayment System at Lancaster.—At the meeting of the Lancaster Town Council, last Wednesday, Mr. Helm stated that the profits arising from the automatic prepayment gas-meters since their introduction had been equal to 6·12 per cent. per annum on the outlay on the meters; and their adoption had brought about a very encouraging increase in the consumption of gas.

Fylde Water Company.—At a meeting of the Fylde Water Company held last Thursday, the shareholders' approval was given to the Bill to be promoted by the Directors to obtain power to raise capital and construct additional works. The amount to be applied for will be £250,000, with borrowing power to the extent of £65,000. It is proposed to extend the supply to the townships of Miferscough, Cockerham, and Forton. Ten years is the time fixed for the completion of the works. The Bill is to be opposed by the St. Anne's District Council, who will join the other local bodies in the proposal to purchase the undertaking for £650,000, which has been offered by them.

Extensions at the Rugeley Gas-Works.—The Rugeley Gas Company have made considerable extensions and additions to their works and plant. They consist of new wrought-iron vertical annular condensers; new boiler and engine house, with egg-ended boiler, and an engine and exhauster; purifying-house and lime-shed, with iron roof, columns, and girders; four purifiers, 12 ft. by 8 ft. by 4 ft. 6 in., and 10-inch Weck's patent centre-valve; traveller with lifting-gear, &c.; and new 10-inch mains and connections throughout the works. The extensions have been carried out to the plans and specifications of the Company's Consulting Engineer (Mr. J. Ferguson Bell, Assoc.M.Inst. C.E., of Stafford), and erected under the supervision of Mr. W. Moult, the Resident Manager; and they are giving every satisfaction. The Company will now be able to furnish the town with an abundant supply of gas for some years. The Directors contemplate shortly erecting a new station meter, governor, and regenerative furnaces.

The Tamworth Water Committee and Income-Tax.—A demand having recently been made upon the Tamworth District Water-Works Joint Committee for the payment of income-tax, it was resolved to take Counsel's opinion upon the matter. When the works were first started, the capital was borrowed jointly by the Urban and Rural Sanitary Authorities, repayable by annual instalments of principal and interest. At the quarterly meeting of the Committee yesterday week, the reply of Counsel (Mr. A. Macmorran) was read. He said there could not be much doubt that the sums paid by way of interest on the borrowed money were liable to income-tax; and any such doubt would be removed by the decision in the Aberdeen case. But the case of the money devoted to the repayment of principal was not at first so clear. He was, however, of opinion that this money was profit, and as such was liable to income-tax, though it might have to be employed in the repayment of borrowed capital. If the surplus belonged to a private person carrying on the water-works with borrowed money, it was clear that the surplus would be none the less profit because he applied it in any particular way. The mode of the application made no difference whatever to the question of what is profit. It appeared to him that the Committee could not claim exemption from payment of income-tax on the surplus accruing to them, whether it was applied in payment of interest on loans or in repayment of the principal of such loans. Under the circumstances, the Committee decided not to appeal against the payment of the tax, although several members contended that the water-works really made no "profit."

New Holder for the North Bierley Gas Company.—Messrs Robert Dempster and Sons, Limited, of Elland, have secured the order for a three-lift holder, 80 feet in diameter, to be erected at the North Bierley Gas-Works, Openshaw, near Bradford.

A Deficiency in the Water-Works Revenue at Idle.—Owing to serious deficiencies in the finances of their Water Department, the Idle District Council have been compelled to withdraw the discount of 10 per cent. which has hitherto been allowed on water accounts. During the three years ending in 1893, the profits dropped to almost vanishing point. In 1891 there was a profit of £813; in 1892, £158; and in 1893, £40. At the end of 1893, there was a credit balance of about £1500; but since then this sum had been swallowed up. In 1894, there was a loss on the water account of £317; in 1895, a deficiency of £413; and this year it was estimated that the loss would amount to about £957. A considerable amount of the present deficit is accounted for by leakages in the pipes, to which more attention is to be paid in the future.

The Special Gas Committee of the Dublin Corporation.—Towards the close of the proceedings in connection with the usual ceremonies attending the installation of the new Lord Mayor of Dublin on New Year's Day, a motion was submitted by Mr. Buckley to the effect that the Special Gas Committee for the year 1896 should consist of the members of the Electric Lighting Committee—viz., Aldermen V. B. Dillon, Mulligan, and Flanagan, the Right Hon. J. M. Meade, Sir R. Sexton, Aldermen Toole, O'Reilly, and J. Reilly, and Messrs. Tallon, Downes, T. Kennedy, M. O'Reilly, Buckley, M'Coy, Hatch, and Lenehan. Alderman Mulligan seconded the motion. Alderman Pile thought the motion should be postponed, as it was of a contentious character. Mr. Smyth agreed. Mr. Buckley remarked that no motion on the gas question could be moved which was not opposed. It was most important that they should have a Special Committee in charge of it. Alderman Pile thought the history of the Committee was not creditable to the Corporation, as they conducted their proceedings with closed doors. Alderman Dillon denied this; and said every member of the Council was free to attend the Committee. He suggested that the motion be amended by adding Mr. Smyth's name. This was agreed to.

Gas Explosions.—About nine o'clock on Monday evening last week, a gas explosion, followed by fire, occurred at an oil stores on Blackheath Hill, Greenwich. The house and contents were seriously damaged; but the shop and oil-vaults were saved. The wife of the proprietor was badly burned; and a passer-by was injured by falling glass. Owing, it is believed, to the defective sealing of a chandelier slide, a serious explosion of gas occurred last Saturday morning on the premises of Mr. Claud Constant, poulterer and cheesemonger, No. 681, Holloway Road. Mr. Constant had occasion to go into the drawing-room on the first floor, when he detected a slight smell of gas, and at once opened the windows. Then he struck a match with a view to testing the burners; and immediately an explosion ensued. Mr. Constant fell stunned to the floor. The windows of the room were blown into the street, and the door was wrenched from its hinges and thrown over the balusters into the passage below. The other windows and doors in the house were blown out, and serious damage was done, while the drawing-room was set on fire. A great crowd collected outside the shop, and a number of persons ran into the house and rescued Mr. Constant. In a few minutes, fire-engines arrived, and the flames in the drawing-room were extinguished. Meanwhile a little boy who had been staying in the house was missed. Search was made, and on the fallen door (over which a number of people in their excitement had trampled) being removed, the lad's body was found underneath. It was at once conveyed to the Great Northern Central Hospital; but life was extinct. Mr. Constant and his daughter Gladys were severely, but not dangerously, injured.

GWYNNE & BEALE'S

PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 65,095.

GWYNNE & CO.,

HYDRAULIC AND GAS ENGINEERS,

BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

Late ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON.

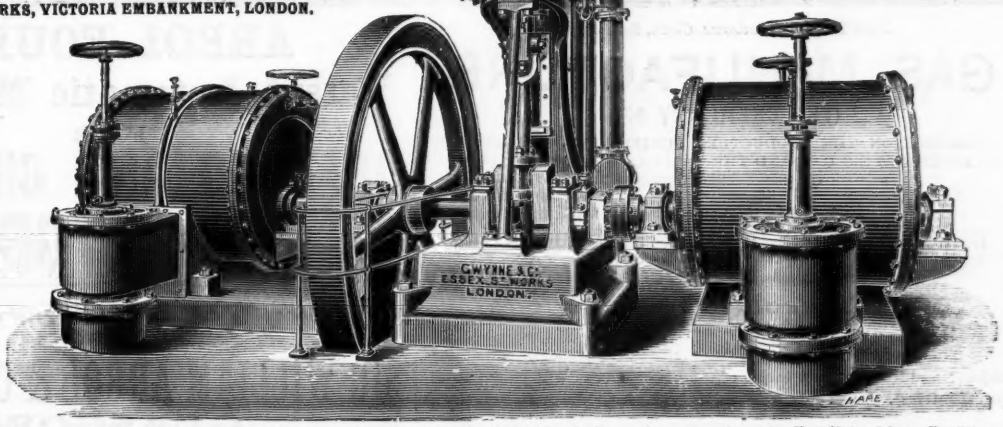
They have completed Exhausters to the extent of 32,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

Their Exhausters can be made, when desired, on their New Patent Principle to pass Gas without the slightest oscillation or variation in pressure.

MANY SIZES OF EXHAUSTERS KEPT IN STOCK.



Exhausting Machinery at Fulham and Bromley Gas-Works, London—each set passing 400,000 cub. ft. per hour drawing 14 miles distant from Beckton.

Catalogues and Testimonials sent on application.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

JOHN WM. O'NEILL, Managing Director,
Palmerston Buildings, Old Broad Street, London, E.C.

ANDREW STEPHENSON, AGENT. All communications *re* Oxide to be addressed to Palmerston Buildings.

WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr. In use in most Continental Gas-Works, and in more than 300 British Gas-Works

ANDREW STEPHENSON,
182, GRESHAM HOUSE,
OLD BROAD STREET,
LONDON, E.C.

Telegrams: "Volcanism, London."

AMMONIACAL LIQUOR Wanted.
BROTHERTON AND CO., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS TAR Wanted.
BROTHERTON AND CO., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SPENT OXIDE Wanted.
BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BROTHERTON & CO.
Offices: Commercial Buildings, LEEDS. Correspondence invited.

GOLD MEDAL, 1892.

TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See p. 6, last week's issue.)
Telegrams: "HUTCHINSON BROS., BARNSLEY."

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c. CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special Attention to Repairs.
Before placing Orders, please write for Estimate.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

CARBIDE OF CALCIUM and Exley's Patent Acetylene Gas Generator sold by READ HOLLIDAY AND SONS, Limited, HUDDERSFIELD.

DRAWINGS, Tracings, &c., promptly executed by experienced Gas Engineering Draughtsman.
J. L. FEATHERSTONE, 76, FINSBURY PAVEMENT, and 27, FORE STREET, E.C.

BACK-PRESSURE IN PURIFIERS.

THE Valve invented by Mr. Cripps for Bye-Passing any Layer of Purifying Material (referred to by the President of the Incorporated Institution of Gas Engineers in his Inaugural Address) can be obtained of the Makers: C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP, and J. EVERY & SON, Phœnix Iron-Works, LEWES, to which Firms all inquiries should be addressed.

W. C. HOLMES & CO., Huddersfield; AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also Improved Patent Rotary Scrubber-Washers.
*** See Advertisement p. II., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock Oldham."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
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Telegrams: "ENAMEL." National Telephone 1759.

NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

SULPHATE OF AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 95, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

WANTED, by a young Man (Age 25), a SITUATION as INSPECTOR or FITTER. Well up in Iron and Compo.; also used to the Inspecting and Testing of Meters, and all Gas-Works routine.
Apply, by letter, to No. 2614, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THREE Draughtsmen wanted, for Gas Engineering Works. Must be capable of preparing accurate Working Drawings and Quantities.
Apply, stating Age, References, and Wages required, to No. 2613, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Draughtsman, by a Firm of Gas-Works Plant Contractors. One accustomed to details of Retort-Settings preferred.
Apply, in confidence, stating Age, Experience, and Salary, to No. 2612, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS-ENGINE, for Sale—One-Horse Power, by Crossley Bros., equal to new. Removed for larger one.
Apply to W. CLARK, 21 and 22, Middle Avenue, The Market, OXFORD.

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore.
Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER LINCOLN."

THE Undersigned is in a position to supply, at the very lowest Prices, the most suitable kind of BENZOL for enriching Gas, made from Hardman's Patent Carbonization Process, of which I am the Sole Patentee. On application, I would furnish Price on the most reasonable terms; giving advice how to utilize it on the most economical method.
J. HARDMAN, Manufacturing Chemist.
Milton, Staffs.

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

It is Worth Your While to Buy DIRECT.
THE RELIANCE LUBRICATING OIL COMPANY SUPPLY on APPROVAL "RELIANCE" NON-CORROSIVE LUBRICANTS (which, through their superiority, have the largest sale in the world)—viz., Engine, Cylinder, and Machinery Oils, 11½d.; Spindle Oil, 8½d.; Gas-Engine and Dynamo Oils, 1s. 6d. per gallon; Barrels Free and Carriage Paid. Also Liquids for Gas Making, Enriching, &c.
RELIANCE LUBRICATING OIL COMPANY, WATER LANE, GREAT TOWER, LONDON, E.C.
Depôts at Liverpool, Bristol, Hull, Glasgow, and Newcastle-on-Tyne. Telegrams: "Subastral, London."

WANTED, at medium sized Gas-Works in Midlands, a GENERAL FOREMAN (Age about 30). Must be a good Mechanic, and one acquainted with modern Drawing and Charging Machinery preferred. Wages, 35s. per week, with House, Gas, and Coal on the Works free.
Address, with references, No. 2615, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

MOSSLEY CORPORATION GAS-WORKS.

GAS PLANT FOR SALE.

THE Gas Committee have the following PLANT for disposal: Four lengths of ▽ HYDRAULIC MAINS, 36 feet each by 2 ft. 3 in. by 21 in. inside, each length pierced for four sets of 5-inch dips, with six in each set; 96 ⊢-PIPES; 10 ROLLED JOISTS, 20 feet each, for carrying Hydraulic and Foul Mains; BUCKSTAVES; CHANNEL STAYS for fronts of Settings; Steel Blocked RETORT-LIDS, with Handles, Cross-Bars and Screws, Mouthpieces, &c.
The whole of the above will be taken down in a few weeks, and may now be seen at work here.
Any other Particulars may be obtained on application to the Manager, Mr. R. Merrell.
Gas-Works, Mossley,
Jan. 8, 1896.

KILMARNOCK GAS CORPORATION.

TENDERS FOR GASHOLDER.

THE Gas Committee of the above Cor- poration invite PLANS and SPECIFICATION for the supply and erection of a 100 feet diameter GASHOLDER, in two Lifts of 30 feet deep each.
Full Particulars will be supplied by applying to the undersigned at the Works.
Sealed offers, marked "Tender for Gasholder," addressed to the subscriber, must be lodged not later than Monday, the 27th inst.
The lowest or any offer may not be accepted.
WM. FAIRWEATHER,
Manager.
Jan. 10, 1896.

Now Ready, Handsome Cloth, 9s. Post free,

GAS MANUFACTURE
(THE CHEMISTRY OF);

HANDBOOK ON THE PRODUCTION, PURIFICATION, AND TESTING OF ILLUMINATING GAS, AND THE ASSAY OF THE BYE-PRODUCTS OF GAS MANUFACTURE.

For the Use of Students.

By W. J. ATKINSON BUTTERFIELD, M.A., F.C.S.,

Head Chemist, Gas-Works, Beckton, London, E.

WITH NUMEROUS ILLUSTRATIONS.

*** This work deals with the MOST MODERN DEVELOPMENTS of the subject; and the chapter treating of the BYE-PRODUCTS will be found of special interest.

London: CHARLES GRIFFIN & Co., Ltd., Exeter Street, Strand.

ARROL-FOULIS
Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,
GLASGOW.

[See Illustrated Advertisement, Jan. 7, p. 47.]

FOR SALE—A Sulphate of Ammonia SATURATOR, 6 ft. by 4 ft. by 4 ft., 20-lb. Lead, strong Wood Frame. Worked only one week. Made by Cairns and Laing, Glasgow. Cost £40.
Offers to No. 2610, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FENTON URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply and delivery of 3000 Tons of good GAS COAL or BURGY.
Form of Tender and Particulars may be obtained from the Manager.
Sealed tenders, addressed to the Chairman, Gas-Works, Fenton, and endorsed "Gas Coal," to be forwarded on or before Monday, the 20th inst.
F. H. DARWIN,
Manager.
Gas Offices, Fenton,
Jan. 10, 1896.

NEWARK GAS COMPANY.

THE Directors of the above Company invite TENDERS for the excavation for, and erection of, a BRICK and PUDDLE TANK, 108 feet in diameter and 24 ft. 6 in. deep, on their Premises, Whitfield Street, Newark.
A Plan of the same can be inspected, and Specifications obtained (on payment of 5s., which will be returned on receipt of *bonâ-fide* tender) on application to the undersigned.
Sealed tenders to be sent in on or before Monday, Jan. 27, 1896.
FREDK. B. FOOTTIT, Secretary.
Newark, Jan. 7, 1896.

CHIGWELL, LOUGHTON, AND WOODFORD GAS COMPANY.

200 £10 SHARES, RANKING FOR 7 PER CENT. DIVIDEND.

MR. ALFRED RICHARDS is instructed by the Directors to SELL THE ABOVE BY AUCTION at the Castle Hotel, Woodford, on Wednesday, Jan. 22, at Six for Seven o'clock precisely in the Evening, in Lots.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Trustees of the Will of Mrs. Sarah Wilson, Deceased, and Others.
GAS SHARES AND STOCK.
West Ham Gas Company, 370 Shares.
Redhill Gas Company, 75 Shares.
Harrogate Gas Company, £2000 Debenture Stock.
Eastbourne Gas Company, 50 Shares.
Romford Gas Company, 15 Shares.
Sunbury Gas Consumers' Company, 25 Shares.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Monday, Jan. 27, at Two precisely, in Lots.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

STOCKS AND SHARES IN THOROUGHLY SOUND, WELL-ESTABLISHED DIVIDEND-PAYING COMPANIES.

J. A. & W. THARP will Sell by Auction at the Mart, E.C., on Thursday, Feb. 6, at Two o'clock, SHARES in—
The Lea Bridge, Leyton, and Walthamstow Tramways Company.
The Patent Victoria Stone Company, Limited.
The London General Omnibus Company, Limited.
The National Safe Deposit Company, Limited.
The Commercial Gas Company.
The West Ham Gas Company.
The Romford Gas Company.
And also
London Bridge Water-Works Annuities (payable by the New River Company).
Particulars of the AUCTIONEERS, 9, Norton Folgate, BISHOPSGATE STREET, E.C. Telephone No. 11,342.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that a Firm of F. J. Putz & Co., 16 and 17, Great St. Helen's, London, are advertising for sale Incandescent Gas-Light Apparatus called the "Champion" Incandescent Gas-Burner, and are stating in their circular that such Apparatus may be legally sold throughout the United Kingdom without Infringement of any existing Patent.

This is to Give Notice to the Public and the Trade that Actions for Infringement of Patent and for an Injunction will be immediately commenced by the Incandescent Gas-Light Company, Limited, against any persons using or selling such Apparatus.

The validity of the Company's Patents has already been certified by Mr. Justice Romer; and Solicitor and Client costs will be enforced in all cases.

FAITHFULL & OWEN,
11, Victoria Street, S.W.
Solicitors for the Incandescent Gas-Light Company, Limited.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, **Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—**

The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, **the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.**

(Signed) **FAITHFULL & OWEN,**
Solicitors for the Incandescent Gas-Light Company, Limited.

NOTICE.

Whereas it has come to the knowledge of the INCANDESCENT GAS LIGHT COMPANY, Limited, of Palmer Street, Westminster, that a Company called the "Meteor" Incandescent Lighting Company, Limited, is selling and offering for sale a form of Incandescent Gas Light known as the "Meteor" Incandescent Gas Light.

This is to Give Notice that the Incandescent Gas Light Company, Limited will commence actions for infringement of their Patents against all persons found dealing in any manner with the said "Meteor" Incandescent Gas Light which is constructed in infringement of the Patents of the Incandescent Gas Light Company, Limited. The validity of these Patents has been established, and a certificate to that effect has been granted, by the Hon. Mr. Justice Romer.

FAITHFULL & OWEN,
11, Victoria Street, S.W.
Solicitors to the Incandescent Gas-Light Company.

NOTICE.

The attention of the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an Action has been commenced to restrain such threats, and that they are PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL,
1, Copthall Buildings, London, E.C.,
Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.
Nov. 30, 1895.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
And at STROUD, GLOUCESTERSHIRE.

TO ENGINEERS & MANAGERS.

ESTABLISHED OVER 50 YEARS.

This is to certify that I, SAMUEL NELSON, am the only ORIGINAL MAKER of the SOLID LEAD SATURATOR, or the CASED SATURATOR.
All Estimates given free for Lead Chemical Burning, and also Contracts for Sulphate Saturators.

Note Address—
20, SPRING GARDENS, BOLTON,
Lancashire.
Please write for Estimate before ordering elsewhere.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS:—

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COAL-FIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.,
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

LOW MOOR BLACK BED GAS COAL.

YIELD OF GAS PER TON - 10,375 CUBIC FEET.
ILLUMINATING POWER - 17·50 SPERM CANDLES.
COKE . . . . . 75 PER CENT.

Prices, f.o.r. or f.o.b., on application to
GEORGE & JOHN HAIGH,
RAVENS LODGE AND CONYERS' COLLIERIES,
DEWSBURY.

A TRIAL IS RESPECTFULLY SOLICITED.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

LONDONDERRY GAS COALS

FROM THE
MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THORNLEY GAS COALS

WORKED BY THE
WEARDALE IRON & COAL Co., Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . . 10,500 Cub. Ft.
Illuminating Power . . 16·9 Candles.
Coke (of good quality) . . 67·5 per Cent.
Sulphur . . . . . 0·58 ,,
Ash . . . . . 2·73 ,,

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

W. E. SANDER,

COMMISSION AGENT, BERLIN, 41, FRIEDRICH STR.

SPECIALITIES: Incandescent Lamp Burners and Mantles (with or without electric lighting from any distance, by button from the wall, etc.).

INCANDESCENT SPIRIT LAMPS.
Electro-technical Ware of all kinds.
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OXIDE OF IRON.

NATURAL BOG ORE FROM OWN MINES.
Samples and Prices on application.
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TRADE MARK: "Compascum." Telegraphic Address: "FERRUM."

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Sulphate of Ammonia Plant
ON THE CONTINUOUS SYSTEM

Is the newest in the Market, and is the outcome of practical experience in Sulphate Making.

Old Systems easily and cheaply converted.

ANY SIZE ERECTED COMPLETE AT HOME OR ABROAD.

Write for Particulars, Testimonials, and References to
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GAS AND CHEMICAL ENGINEERS,
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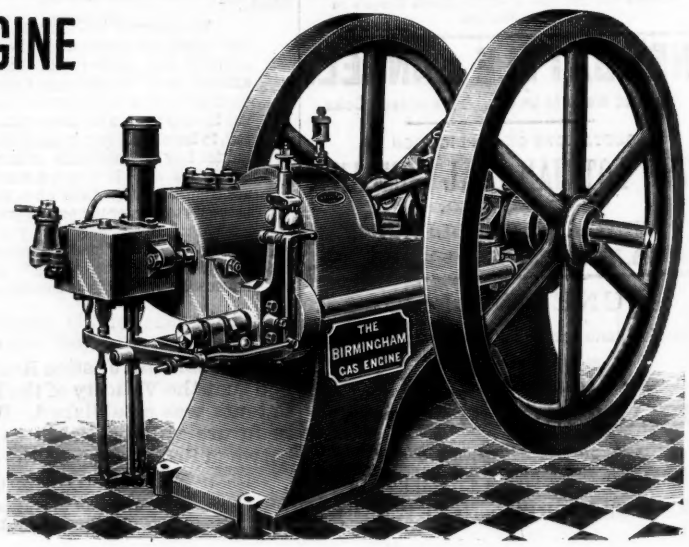
THE BIRMINGHAM GAS-ENGINE
"OTTO" CYCLE.

A thoroughly reliable Engine for Commercial or Electric Lighting Purposes. Simple, Strong, Interchangeable.

Adopted by the Corporation of Birmingham Gas Department for Driving the Conveyors at their Swan Village Works.



WILLIAM GRICE & SONS,
Engineers and Founders,
FAZELEY STREET, BIRMINGHAM.
LONDON REPRESENTATIVE: Mr. SAM PUPLETT, M.I.M.E., 47, Albany Buildings, Victoria Street, Westminster.

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FIRE-CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

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Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

HUNTER'S
OXIDE OF IRON.
JAMES HUNTER, MINER, AND SHIPPER OF
NATURAL IRISH BOG ORE.
This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.
Samples and Prices on application.
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Telegrams: "HUNTER, PORT GLASGOW."
Established 1872.

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MANUFACTURERS OF
FILES OF BEST QUALITY
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STEEL OF ALL DESCRIPTIONS.
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LONDON OFFICE:
90, CANNON STREET, E.C.

BOLDON GAS COALS.
Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the
HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
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GASEOUS FIRING A SPECIALTY.

Telegraphic Address:
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RETORT SETTERS.
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PATENT SELF
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PATENT REGENERATIVE
FURNACES.
FOR ENGLAND, WALES & ABROAD.
OVENDEN, HALIFAX.

Telephone No. 43.
HALIFAX EXCHANGE.

CONTRACTORS.
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SOLE MAKERS OF
"SETTLE'S"
PATENT COMBINED
SEAL-REGULATING
FLUSH-VALVE.

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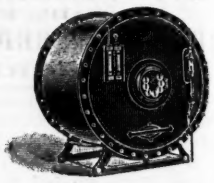
JAMES MILNE & SON, LTD.,

GAS ENGINEERS,

MILTON HOUSE WORKS, EDINBURGH.

LONDON. — GLASGOW. — LEEDS.

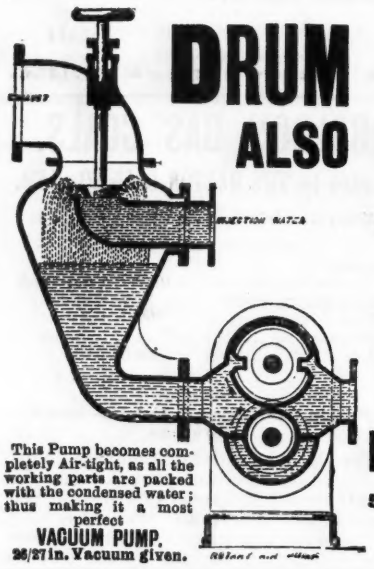


"The Force of the Piston Pump with the Capacity of the Centrifugal combined."

JOHNSON'S PATENT

DRUM PUMP AND EXHAUSTER

ALSO VACUUM PUMP AND CONDENSER.



This Pump becomes completely Air-tight, as all the working parts are packed with the condensed water; thus making it a most perfect

VACUUM PUMP.

26/27 in. Vacuum given.

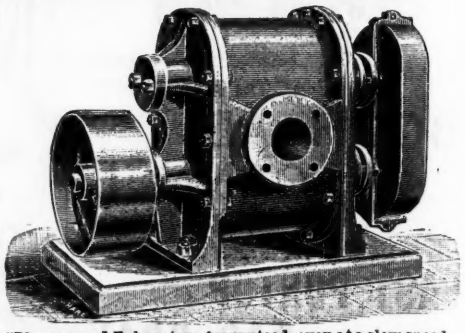
No Priming, Valves, or Frictional Working Parts.

The Pump of the future for quickly and economically moving large Bodies of Water, Semi-fluid, &c.

DRUM ENGINEERING Co.

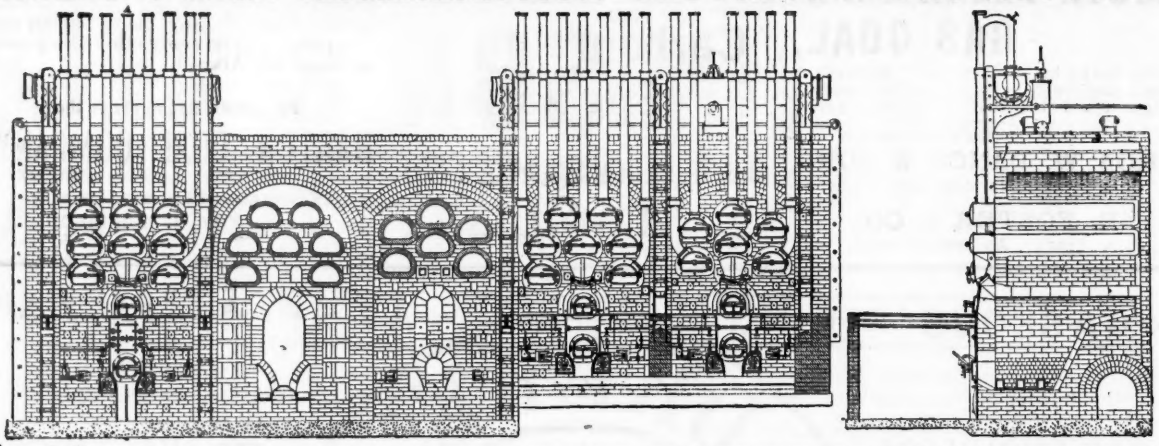
55, ATHOL ROAD,

BRADFORD.



Blowers and Exhausters guaranteed, even at a slow speed, to give a working pressure of 3 lbs. and upwards, and this without losing power by creating frictional Heat.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.

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Established 1790.

MANUFACTURERS OF EVERY DESCRIPTION OF GAS PLANT,
FROM
RETORTS
TO
GASHOLDERS

FOR WHICH THEY HAVE THE NEWEST AND MOST MODERN MACHINERY.

GASHOLDERS CAN BE MADE OF ANY DIAMETER AND PUT TOGETHER AT THE WORKS.

Holders having a capacity of **8,000,000** Cubic Feet have been made and erected; the largest one being 181 feet diameter by 136 feet 9 inches deep. Riveted entirely with ⅞-inch diameter Hot Rivets.

WE ERECT GASHOLDERS EITHER WITH OR WITHOUT FRAMING.
NO ROYALTIES TO PAY FOR PATENTS.
SOLE MAKERS OF
COATES' IMPROVED PATENT FURNACE DOOR PROTECTOR,
Which has been approved and adopted by the Gas Authorities at
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Telegraphic Addresses: "WHESSOE, DARLINGTON." "WHESSOE, LONDON." | T. COATES, MANAGING DIRECTOR. | WORKS: DARLINGTON. LONDON OFFICE: 28, QUEEN STREET, E.C.

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MAKERS OF LEEDS
LARGEST GASHOLDER IN THE WORLD
ALSO THE LARGEST METAL TANK
See Advertisement last week, also next week
MAKERS OF RETORT-LIDS OF ALL FORMS & SHAPES BY SPECIAL HYDRAULIC MACHINERY

MOBBERLEY & PERRY
STOURBRIDGE.
Manufacture & supply best quality of
Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)
Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.
FIRE BRICKS, LUMPS, & TILES, BLUE STAFFORDSHIRE VITRIFIED BRICKS FOR PAVING, &c., &c.
EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.
Contractors for the erection of Retort-Benches complete.
London Agents:
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GAS-BURNERS

BRAY'S

"SPECIAL" & "ADJUSTABLE" BURNERS

Are the Best for General Use, and will, at their

REDUCED PRICE,

Save their Cost in Gas alone in Forty Hours' use.

SCREWED FOR GLOBE HOLDERS

The "Adjustables" are specially adapted for use with Penny-in-the-Slot Meters, for which purpose large quantities have been sold.

THE "CODAC" ECONOMISER.

Ordinary Regulator Burner with "Codac" Top on.

A cheap adaptation of Bray's "ADJUSTABLE" BURNER, not so efficient, but acceptable for some purposes. The top part only is required, and is made merely to slip on to our ordinary Regulator Burners, which are in use throughout the world. Made in Union Jets and Batswings.

Ordinary Regulator Burner with "Codac" Top on.

SEND FOR PRICE LIST AND CATALOGUE.

GEO. BRAY & Co., Gas-Lighting Engineers, LEEDS.

ALEX. C. HUMPHREYS, M.Inst.C.E. A. G. GLASGOW, M.E.

MESSRS. HUMPHREYS & GLASGOW

Have constructed their EUROPEAN type of

CARBURETTED WATER-GAS PLANT

At the following Gas-Works:—

Copenhagen	700,000 Cub. Ft.	Brussels	700,000 Cub. Ft.
Belfast	1,700,000 „	Liverpool	2,500,000 „
Glasgow	300,000 „	Tottenham	600,000 „
Santiago	400,000 „	Brighton	1,250,000 „
Swansea	700,000 „	Bath	1,000,000 „

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Manchester	3,000,000 Cub. Ft.
Preston	1,500,000 „	New York	1,000,000 „
Southport	750,000 „	Newburgh, N.Y.	350,000 „
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In addition to which the previous Installations of The Gaslight and Coke Company under this System have a total capacity of 10,000,000 cubic feet per diem.

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Proprietors of

ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
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HAS BEEN ADOPTED AT THE FOLLOWING WORKS—

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IT IS SIMPLE, CONVENIENT, AND EFFICIENT.

The MANAGER of the RUGBY GAS-WORKS writes—

"I have pleasure in stating that the Apparatus has given me the greatest satisfaction, and continues to do the work required of it most admirably. Since its erection, it has effectually stopped the slightest trace of tar from passing beyond the lower chambers (although our condensers are inefficient), and has completely purified the gas from Ammonia, so far as the litmus test reveals it."

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Full Particulars on Application to the Sole Makers—

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IN RETAIL OR WHOLESALE QUANTITIES.

For Prices apply to

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RETORTS AND FIRE-BRICKS.

BEST QUALITY.

KING BROTHERS, STOURBRIDGE.

[See Illustrated Advertisement, Jan. 7, p. III., centre of "JOURNAL."]

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UPPER GROUND STREET, LONDON, S.E.,

SUPPLY FROM STOCK

CAST-IRON RETORTS.

AND ALL KINDS OF GAS-WORKS APPARATUS.

SOCKET-PIPES FOR GAS OR WATER PURPOSES.

FLANGE PIPES FOR STEAM.

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ETNA WORKS,

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NEAR BIRMINGHAM

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Drawings, Specifications, and Estimates supplied.

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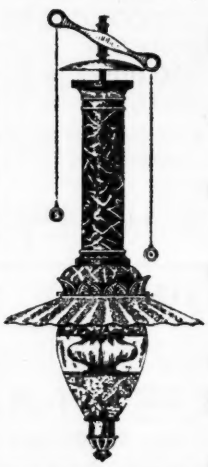
Established 1860.

The Climax of Regenerative Gas Lighting!!



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A 280-CANDLE POWER PLAIN IRON LAMP,

CLASS A— **55/-**

LIGHT for LIGHT less than half the price of any other Regenerative Lamp.

Manufactured in England.

HENRY GREENE & SONS,

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PARTICULARS AND PRICES FREE. AGENTS WANTED.

BEST & LLOYD

MAKERS OF **BIRMINGHAM.**

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WITH PATENT SHADE.

The ONLY GAS-PENDANT suitable for Domestic Lighting; a room 18 ft. by 14 ft. being beautifully illuminated with one Incandescent Burner.

Extract from the JOURNAL OF GAS LIGHTING, Jan. 8, 1895.

"IN CONJUNCTION WITH

THE INCANDESCENT GAS-LIGHT,

it quite **supersedes** the familiar three-light pendant. We are able to bear witness to the **convenience** of the New Pendant."

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

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TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE NO. 200.

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Incorporated with the Leeds Fire-Clay Company, Ltd.,

WORTLEY FIRE-CLAY WORKS,

Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT

MACHINE-MADE GAS-RETORTS.

GAS AND WATER PIPES

AND

CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

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Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.

MANUFACTURERS OF GLASSHOUSE POTS AND CRUCIBLES OF EVERY KIND.

ESTABLISHED 1836.

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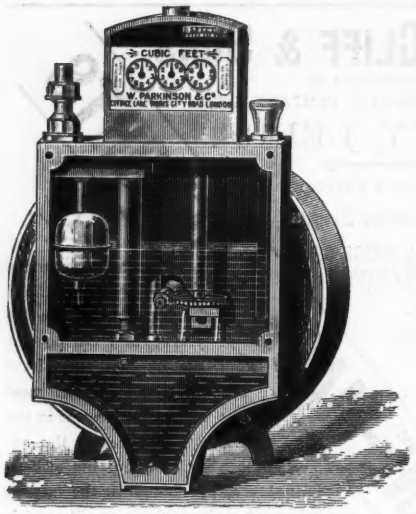

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[See also Advt. p. 62.

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